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Hyperthyroidism

Diagnosis and Treatment

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HYPERACTIVITY of the thyroid gland is seen fairly often in the personnel of the Armed Forces and their dependents. Women show a higher incidence of this disease than men, the ratio being about 4:1 (*1*). No satisfactory explanation has been given for this observation, but perhaps the balance of the endocrine system is more easily disrupted in women than in men. The cyclic ovarian functional episodes doubtless also affect the thyroid, adrenal, and pituitary glands. Although the symptoms and signs of hyperthyroidism are classical and may be clearly demonstrated in most patients, some atypical and confusing findings may be present which must be properly and quickly evaluated in order to prescribe the appropriate therapy. The evaluation of the history and physical examination is more important than are such laboratory determinations as the basal metabolism rate, blood serum cholesterol level, urinary creatine excretion, and the blood protein-bound iodine determination.

Patients with hyperthyroidism may complain of excessive perspiration, which is warm rather than cold and clammy. Weight loss is unusual in that they ordinarily have an excellent appetite and ingest

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large quantities of food. Their assimilation of this food is usually not disturbed by their moderate diarrhea. Probably a good deal of the weight loss is caused by muscular overactivity and increased nervousness and irritability, while some is a result of increased basal oxygen utilization. Nervousness is significant in that it responds better than the nervousness and irritability of a psychoneurotic patient to the care of a solicitous and sympathetic physician in whom the patient has confidence. Above all, patients with hyperthyroidism must be treated with sympathetic understanding at all times, by the physicians, nurses, and attendants.

Insomnia may be present but is usually not a major complaint as in patients with an anxiety neurosis or mental conflict. Muscle weakness cannot be relied on as a differential point since it is found in certain neurologic disorders, but it can be readily demonstrated clinically in the leg muscles. Lahey (*2*) states that there is actual muscular dystrophy in this disease. Practically all patients with true hyperthyroidism prefer cold weather. Exophthalmos is a variable diagnostic point that will be discussed in connection with therapy. Diffuse or nodular enlargement of the thyroid gland is associated, in most patients, with toxic activity, but occasionally patients, usually over 50, and more often over 60 years of age, show all the usual signs and symptoms of hyperthyroidism except that there is no palpable increase in the size of the gland, and no enlargement is demonstrated substernally by roentgenographic studies. Lahey has called this state "apathetic hyperthyroidism." No immediate cause is known, but emotional trauma and acute upper respiratory infections seem to be precipitating factors in some patients. A large number of cases occur in the third and fourth decades, and the disease is commonly found in more than one member of a family.

PRESENT FORMS OF THERAPY

Psychotherapy, in the form of suggestion and assurance, has been used in treating most medical and surgical lesions throughout the ages, and can be of great help when used in conjunction with other measures. It is possible that psychotherapy alone could cause a remission of the disease.

Thyroid extract in carefully regulated doses has been given in the hope it might be of more value than the supposedly abnormal secretion produced by the diseased gland. By means of this drug the thyrotropic hormone of the anterior pituitary gland would be inhibited and consequently the symptoms of thyrotoxicosis would be diminished. According to McGavack (*3*) thyroid extract decreases the output of hormone by the thyroid gland but increases the metabolic process. Haines et al. (*4*) and Gargill and Lesses (*5*) report that thyrotropic hormone produces exophthalmos when it is found

in excess, and that it can be inactivated by thyroid tissue with subsequent improvement of the exophthalmic state.

Irradiation of the pituitary gland has been tried in animals in an effort to diminish the output of thyrotropic hormone, which can produce thyrotoxicosis and exophthalmos. This, however, is not practicable in human beings since other functions of the anterior pituitary gland are affected adversely.

Irradiation of the thyroid gland was used more frequently several years ago than at present to decrease the amount of functioning organ and thus reduce the symptoms and signs of hyperthyroidism. This did not prove satisfactory because of the difficulty in determining the correct dosage for proper results. The resulting fibrosis was also a disadvantage in that it added technical obstacles to surgery. Furthermore, fibrosis of other organs in the neck occurred.

Radioactive iodine with a half-life of 12 hours was used experimentally in 1938. Gargill and Lesses gave doses up to 25 microcuries (estimated at 0.5 to 1 microcuries per gram weight of thyroid). Good results were reported in 80 percent of the patients. Soley and Miller (*6*) used tracer doses of from 100 to 250 microcuries I^{131} and therapeutic doses of 1,000 to 2,000 microcuries in thyrotoxicosis and up to 50,000 microcuries in patients with metastatic carcinoma of the thyroid gland. They stated that the normal thyroid absorbed less than 30 percent of the administered radioactive iodine while the hypofunctioning gland absorbed much less, and the overactive gland absorbed 40 to 80 percent. Haines and his coworkers agreed but added that although radioactive iodine is useful, the clinic using it must have a well-qualified physicist, chemist, and hematologist in addition to the usual staff of physicians so that the treatment can be accomplished properly and safely.

Iodine, usually in the form of potassium iodide, has been administered since 1923 as a form of treatment of hyperthyroidism in itself, or more usually as part of the preoperative preparation of the patient. The mechanism of the action of iodine on the overactive thyroid is not understood, but it is thought that it inhibits the production of thyrotropic hormone by the anterior pituitary. The normal thyroid requires as little as 0.075 mg. of iodine daily for iodination and the formation of thyroxine (*5*). The hyperfunctioning gland calls for two or three times as much or more in order to cause involution of the gland and consequently decrease the basal metabolism rate and the other signs of toxicity. McGavack explained that excess potassium iodide interferes with the synthesis of diiodotyrosine and thyroxine in the thyroid gland both in vitro and in vivo. Barr stated that iodine alone seldom gives permanent relief of symptoms. Haines and his coworkers used Lugol's solution for the preoperative treatment of mild

cases of thyrotoxicosis. Bartels (*7*) also recommended this, with the advice to continue it until the full benefit is derived—a month or more before operation. Lahey (*8*) reported that some patients become iodine-fast and that their basal metabolism rate would not drop unless some antithyroid substance, such as propylthiouracil, were given alone. Barr stated that only 3 percent of patients with hyperthyroidism do not respond to iodine administration. Means (*9*) advised the use of iodine alone in the preoperative preparation of a pregnant patient with thyrotoxicosis, since he believed that iodine combined with an antithyroid drug may dangerously affect the fetal thyroid after the first trimester of gestation. Iodine slowed down the action of propylthiouracil (*8*) and the thiourea-inhibiting action was retarded by pretreatment with iodine, but the ultimate action was increased threefold (*3*). Most physicians probably consider iodine therapy as harmless, but Kyle (*10*) quoted a report of 7 patients with severe iodism, 1 of whom died, in a series of 400 patients treated at Johns Hopkins Hospital.

Antithyroid substances are now considered of the greatest value both for preoperative preparation and also for medical therapy in certain elderly patients, in those with cardiovascular disease, diabetes mellitus, asthma, or psychosis complicating thyrotoxicosis, and in those who refuse operation. The action of these substances can be better understood if we consider the formation of thyroxine, which is an iodine-containing amino acid. Inorganic iodine and tyrosine form diiodotyrosine, which through enzymatic action in the thyroid gland by cytochrome oxidase and peroxidase with manganese acting as catalyst forms tetraiodothyronine or physiologically active thyroxin. The biosynthesis of thyroxin is considered an intracellular, aerobic, and enzymatic process. Hypophysectomy in animals decreases the incorporation of iodine into the thyroid. In rats it has been demonstrated that the liver, muscles, and small intestines contain thyroxin and diiodotyrosine 2 to 8 months after complete thyroidectomy.

It is thought that propylthiouracil acts by interfering with the enzymatic system necessary in the production of thyroxine from iodine and not by preventing the absorption of iodine by the thyroid (*7*). Thus, it decreases synthesis of thyroid hormone, but since the pituitary thyrotropic stimulating hormone is not inhibited, a compensatory hyperplasia of the thyroid occurs. This can be effectively balanced by giving Lugol's solution with the antithyroid drug. The involution produced by the iodine makes the gland firm and decreases its vascularity, thus facilitating the performance of a subtotal thyroidectomy later. Until 1948 subtotal thyroidectomies had been performed on 27,000 patients at the Lahey Clinic, of whom, since July 1943, 1,100 were prepared for operation by use of antithyroid drugs. In an

earlier series of 500 patients so prepared at the same clinic the mortality rate dropped from 0.88 to 0.17 percent.

Hyperthyroidism, caused by an excessive amount or an abnormally synthesized thyroxin, increases the catabolic effects on the liver, heart, muscles, intestinal tracts, and epiphyseal centers in young children, and on the retro-ocular fat and muscles. The retro-ocular changes seem to depend on an excessive thyrotropic hormone production from the anterior portion of the pituitary. Of the several thiourealike substances studied, propylthiouracil, and more recently, methylthiouracil, seem to be the drugs of choice for either medical therapy of hyperthyroidism or preoperative preparation in conjunction with iodine. Remission may occur with propylthiouracil used alone in mild cases, and although relapses also appear when the drug is stopped after 6 to 18 months of therapy, treatment with this type of drug affords the most logical treatment of thyrotoxicosis now known. As to the toxicity of propylthiouracil, Bartels (*11*) reported a series of 672 patients treated preoperatively, with 13 (1.9 percent) reactions, including 7 with leukopenia, 3 with agranulocytosis, and 3 with fever or an eruptive skin reaction. This compared favorably with the reactions in patients treated with thiouracil (15 percent), some of whom died from agranulocytosis or periarteritis nodosa.

Subtotal thyroidectomy is still the most widely accepted form of definitive therapy. In the large thyroid centers and in the hands of skilled surgeons, the results have been excellent. The object is to decrease the production of thyroxin by removing that amount of the gland—60 to 95 percent—that the surgeon believes will alleviate the signs and symptoms of thyrotoxicosis and yet not cause a state of hypothyroidism. This is a difficult problem, because there is no accurate means of determining this amount. Bartels of the Lahey Clinic reports the following complications: (*a*) immediate operative, such as recurrent laryngeal nerve paralysis or tetany following resection of the parathyroid, 0.5 percent; (*b*) myxedema, 2 percent; (*c*) recurrence of hyperthyroidism, 2 percent; and (*d*) operative deaths, 0.17 percent (*7*). Of the recurrent toxic cases about one-half are operated on again, and the other half are treated with Lugol's solution. The number of patients with complicating myxedema or latent tetany (low blood calcium levels but no clinical sign of tetany) is difficult to determine without a detailed clinical and laboratory follow-up of all patients operated on. The intractable form of exophthalmos is more frequently associated with myxedema occurring spontaneously after thyroidectomy or following thyroiditis (*2*). Since the exophthalmos is believed to be caused by an excessive production of anterior pituitary thyrotropic hormone, the best form of treatment, when it occurs in a patient with hyperthyroidism, is to reduce the signs and symptoms of

toxicity gradually with propylthiouracil. It is given alone at first, then combined with Lugol's solution, and as the basal metabolism rate and tachycardia are lowered, daily doses of 16 to 100 mg. of thyroid extract may be added in an attempt to control the thyrotropic hormone response (*3*).

CASE REPORTS

Case 1.—A 28-year-old woman was admitted to the hospital on 13 May 1947 complaining of nervousness, weakness, and a voracious appetite of almost a year's duration. She had lost 21 pounds in the preceding 8 months, but had regained 5 pounds in the month just prior to admission. She had also noticed increased excitability and excessive perspiration. Occasionally she was aware of precordial pain and palpitation. In December 1946, 5 months prior to hospitalization, she felt a weakness and moderate numbness in the right arm after bowling, so she consulted a private physician. He diagnosed her condition as "toxic thyroid disease with anemia" and prescribed Lugol's solution and injections of liver extract. General improvement was noted, but, because of vomiting, the Lugol's solution was discontinued after 3 weeks. About 1 month later an organic iodine preparation was prescribed. She took this by mouth for 6 weeks. Slow abatement of symptoms continued, but she was still excitable in crowds. One month prior to admission, she developed a painful swelling of the feet and legs, and again saw her physician, who gave a few injections of a mercurial diuretic and reinstituted the iodine therapy. She was admitted to the hospital because she noticed blurring of vision, passed 4 or 5 soft-formed stools daily, and the symptoms persisted. One sister has hyperthyroidism.

Physical examination revealed an alert woman weighing 119 pounds, 16 pounds less than her usual weight. Her deep reflexes were hyperactive. Her skin was warm and moist. She had a slight exophthalmos and a myopia with vision recorded as O. D. 20/50 and O. S. 20/100, correctible to 20/20 bilaterally. There was a fine tremor of the tongue and extended fingers. There was a moderately diffuse enlargement of the thyroid. Her pulse rate was 120. Moderate weakness of the quadriceps femoris muscles was present bilaterally.

A roentgenogram of the chest was normal except for slight prominence of the pulmonary conus. The electrocardiogram showed right axis deviation. The basal metabolism rate was plus 87 but dropped to plus 5 by 7 July and to 0 on 28 July, the day before operation. The hemoglobin was 10 per 100 cc. on admission, but increased to 13.5 in 3 weeks.

In addition to bed rest, sedation, and a nutritious diet supplemented by daily oral administration of 40 mg. of thiamine hydrochloride; the patient was treated daily with 45 drops of Lugol's solution, for 22 days. The iodine was discontinued because of a rather poor response, and 200 mg. of propylthiouracil were given daily in 4 doses, for 46 days. In the last 14 days (5 to 19 July) in this therapy, 60 drops of Lugol's solution was also administered to further the involution of the soft thyroid. This was continued alone until 29 July when a thyroidectomy was performed under rectal tribromeothanol and nitrous oxide-oxygen-ether anesthesia. The pathologic report was "hyperplasia with evidence of involution." The patient was discharged from the hospital on 8 August in excellent condition. The patient has been followed for at least 15 months postoperatively. She has appeared well and has regained her weight and strength. Recently she had a hysterectomy for bleeding uterine fibroids.

Comment.—This patient was treated too long on an expectant basis. If, after she entered the hospital, the propylthiouracil had been avail-

able sooner, the period of hospitalization might have been shortened by 3 or 4 weeks. The dosage of propylthiouracil should have been closer to 300 mg. daily at first, then decreased. Extra delay before operation was for the purpose of watching for a possible granulopenic reaction. This is not as necessary with propylthiouracil as it is with thiouracil. The patient certainly received excessive doses of iodine for the involution of hyperplastic thyroid. Ten drops, three times a day, of Lugol's solution would probably have been sufficient for this purpose.

Case 2.—A 26-year-old member of the WACS was admitted on 30 June 1947 complaining of nervousness and loss of weight. In September 1946 she noticed that her eyes were more prominent than usual. Soon after her hands began to tremble when she wrote and she would have dyspnea and palpitation on climbing a single flight of stairs. Even in cold weather she felt warm. No changes in her voice or vision were noted. She felt tired even with supposedly adequate amounts of sleep. She had been admitted to an Army general hospital in Germany in November 1946 with a basal metabolism rate of plus 90. Despite treatment, primarily with phenobarbital, bed rest, and a nourishing diet, she continued to lose weight, and was transferred in February 1947 to an Army general hospital in the Zone of the Interior. Here, for 3 months, 200 mg. propylthiouracil and up to 400 mg. phenobarbital daily was admiinstered for 4 weeks, then the propylthiouracil was increased to 300 mg. daily. No Lugol's solution or other form of iodine was prescribed. The basal metabolism rate was plus 77; 1 week later it was plus 21; while 3 weeks later it was 65 and remained near plus 50 for the next 6 weeks. These tests did not seem reliable, and the physicians' and nurses' progress notes emphasized the uncooperative attitude of the patient and the irregularity of the doses of medicine she received. She was discharged from the hospital on a CDD without perceptible improvement in her general condition. While on terminal furlough her basal metabolism rate was plus 35 (recorded by a hospital in New York City) and she was admitted to this hospital.

The patient's parents had been killed accidentally when she was a child, and she had been reared by foster parents. She was married in 1946 for 6 months, but was separated for incompatibility. She was a rather profane person and smoked about 40 cigarettes daily. She had had a tonsillectomy and adenoidectomy in 1928, an appendectomy in 1934, a severe electric shock in 1943 from a high frequency radio set at which time her heart was alleged to have stopped temporarily; she fractured her left forearm in 1944; she was treated for gonorrhea in 1941, for asthenia in 1944, and for cystitis in 1946.

Physical examination revealed an undernourished woman with moderate bilateral exophthalmos with lid lag, and slight tremor of the tongue and fingers; skin was warm and moist. The thyroid was diffusely enlarged, extremely so on the right side. The apical beat was forceful and the pulse rate 90 to 130 per minute. The knee jerks were hyperactive. The electrocardiogram was normal except for a Q-T interval of 0.37 sec. Basal metabolic determinations were not satisfactory or reliable, varying from plus 20 to plus 70.

The administration of 20 drops of Lugol's solution three times a day did not produce a satisfactory response. Propylthiouracil was substituted 4 weeks later, giving 250 mg. daily, except for 1 week when 350 mg. were given daily. After 25 days of this medication, she was transferred to a neuropsychiatric hospital. During her stay in our hospital she had manifested definite homosexual patterns and was generally uncooperative. During her last week in this hospital and for

another 5 days in the new one, she had an episode of either feigned or hysterical bilateral blindness, which apparently was not complete. Hydrotherapy was required to control her manic behavior. Propylthiouracil was continued in doses of 300 mg. daily for the next 10 days then gradually reduced to 50 mg. until on 15 September treatment with 10 drops of Lugol's solution three times daily was reinstituted and the propylthiouracil was discontinued. A subtotal thyroidectomy was performed on 25 September. A moderately firm gland was found with low colloid and marginal vacuolization, consistent with an involuting toxic thyroid. She was discharged on 24 November after further study of her personality traits and follow-up electrocardiographic studies. The Q–T interval returned to normal limits. The personality of the patient was materially unchanged 4 months postoperatively, although the signs of hyperthyroidism including the exophthalmos had improved.

Comment.—The observation and treatment of this patient for a moderate to severe hyperthyroidism covered a period of 12 months in 4 hospitals, and her symptoms dated back about 3 months prior to the first hospitalization. This is too long a period for a patient in whom surgery was indicated as the definitive therapy. The operation was not performed at the second hospital, probably because of the patient's lack of cooperation. Perhaps the hyperthyroidism was to blame, but it is more likely that her altered personality was the greater obstacle. This is not a suitable case in which to evaluate the long but intermittent use of propylthiouracil, although it seemed to be of definite preoperative value.

Case 3.—A 28-year-old man was admitted to the hospital on 29 October 1947 complaining of loss of 30 pounds in weight over a 4-month period, nervousness and irritability and proneness to weeping for almost a year. His hands were shaky, he perspired freely, and had palpitations. He had noticed his neck getting larger for several months. His mother died during an operation for toxic goiter.

Physical examination revealed a well-nourished man who had lost weight. There was moderate exophthalmos and moderate, diffuse enlargement of the thyroid. The pulse rate was 120. On admission the basal metabolism rate was plus 40 and plus 6 after 8 weeks. The serum cholesterol increased from 176 mg. per 100 cc. of blood on 31 October to 278 mg. on 30 December. The cephalin-cholesterol flocculation test was 3 plus in 48 hours.

Beginning 3 November, 300 mg. of propylthiouracil was given daily for 3 weeks, then 200 mg. daily until 27 December, when the drug was discontinued. Beginning 5 December, 15 drops of Lugol's solution were given three times a day. This was continued through the time of thyroidectomy on 14 January 1948 and until 23 January. The patient was considered ready for operation on 1 January but rather noticeable laryngospasm, which interfered with endotracheal anesthesia, caused the postponement of the operation. Nevertheless, he responded well to surgery and had no postoperative complications. He returned to duty on 12 February.

Comment.—The patient was highly cooperative despite the unfavorable family history, and the earlier preoperative technical difficulty. He made an excellent recovery and was well when seen 11

months after operation. The pathologic diagnosis in this case was "firm (involuted) diffuse toxic goiter."

Case 4.—A 35-year-old woman was admitted on 12 January 1948 because of nervousness and weakness of 8 months' duration. At times she noted slight nausea, but her appetite was excellent. She had lost 10 pounds in the past 6 months. She felt somewhat tremulous and preferred cold weather to warm. For 2 months prior to admission she noted dyspnea and palpitation on climbing a single flight of stairs. At times her eyelids were swollen and for 2 weeks prior to admission she noted a slight swelling of her ankles. About 4 months earlier a private physician had prescribed iodine, which she took for 1 month with relief of weakness.

Physical examination revealed a well-developed woman who had a moderate staring appearance but no true exophthalmos. Her skin was warm and moist and there was a fine tremor of the extended fingers and tongue. The thyroid was moderately and diffusely enlarged; a bruit was heard on auscultation. The pulse was regular; rate of 128 to 146. The basal metabolism rate was plus 40 on admission and within 14 days had dropped to plus 11. The serum cholesterol was 187 mg. per 100 cc. blood.

Beginning 3 days after admission, 300 mg. of propylthiouracil was given daily for 11 days then 250 mg. daily for 14 days. Ten drops of Lugol's solution three times a day were also prescribed after 2 weeks, and continued for 13 days at which time thyroidectomy was performed (11 February). The propylthiouracil was not discontinued until 2 days prior to operation. One hundred and thirty milligrams of phenobarbital were given daily. She gained 14 pounds, her pulse rate decreased to about 72 per minute and she was generally improved. The operation was complicated by the fact that although the thyroid was firm on the left it was still friable on the right side. Nevertheless, the patient made an uneventful recovery and was discharged on 21 February.

Comment.—This patient demonstrated an excellent clinical response to propylthiouracil and iodine, but she did not receive the latter long enough to complete the involution of the thyroid. It is difficult to know whether the iodine and propylthiouracil together should have been given longer or whether the propylthiouracil should have been stopped sooner and the iodine given alone for at least another week. This patient was still in good health when seen 5 months postoperatively, and was at that time in the third month of pregnancy.

Case 5.—A 24-year-old married woman was admitted on 24 February 1948 complaining of nervousness and the loss of 14 pounds in the preceding 5 months. She was easily upset, felt some general lassitude, and noticed that her legs tired easily. She preferred warm weather to cold. Her appetite had not been good for the past 2 months, but she blamed this on the poorer quality of food she was able to buy. Her neck had been getting larger for 2 months.

Physical examination revealed a small woman of below average weight. She did not appear especially restless, nor did she have any exophthalmos. Her hands and feet felt warm, but were not moist with perspiration. The thyroid was slightly nodular with a greater increase in size on the right side. No bruit was heard. The pulse rate averaged 98. The erythrocyte count was 3.86 million and the hemoglobin 9.5 gm. per 100 cc. of blood. The basal metabolism rate was plus 50 and gradually decreased to plus 10 within 4 weeks.

Since this patient had hypochromic anemia and had not been eating adequately, a high caloric, high vitamin diet supplemented by 0.320 gm. of ferrous sulfate three times a day for a month was prescribed. Her erythrocyte count became normal and the hemoglobin rose to 13.5 gm. per 100 cc. of blood. Beginning on 4 March, 200 mg. of propylthiouracil were given daily. Two days later, 10 drops of Lugol's solution were also given three times a day. The propylthiouracil was discontinued after 15 days and the iodine was given until the time of operation (2 April). She had gained 10 pounds in 4 weeks. She was also given phenobarbital. The surgeons stated that the gland on operation was firm and quite avascular. The pathologist reported "involution of a diffuse toxic goiter." The patient was discharged on 12 April.

Comment.—This frail woman responded well to the concurrent administration of propylthiouracil and iodine. It is possible that she would have responded as well to iodine alone. The basal metabolism rate was higher than would be expected from the clinical findings. It was important to treat the hypochromic anemia although it was probably caused by a poor diet and iron deficiency.

DISCUSSION

The recognition and proper treatment of hyperthyroidism is important. The best type of therapy has not yet been determined and there are conflicting views as to whether a patient should be treated medically or by surgery in combination with preoperative medication, or by roentgen irradiation or radioactive iodine. A plan of treatment should be formulated that will best serve each particular patient. The diagnosis is often difficult even when a comprehensive history and clinical examination has been completed. The basal metabolism rate should be of assistance, but may be rendered unreliable either through the patient's lack of cooperation or an error in technique. The protein-bound blood iodine determination is of value in studying hyper- as well as hypo-thyroidism, but this test is still available in only a few research laboratories (*8*) (*12*) (*13*). With the relatively easy accessibility of air transport for the Armed Forces, it is believed that sufficient blood specimens could be forwarded to the Army Medical Department Research and Graduate School in Washington, D. C., to make it feasible to train technicians and physicians or Medical Service Corps officers in the most practicable methods of determining blood serum iodine levels.

In the treatment of hyperthyroidism, many physicians still vacillate between surgical removal of most of the gland and antithyroid drug therapy alone. If medical treatment has been decided on, propylthiouracil can be used for many months or years if the patient is closely observed: this may be done through an out-patient clinic. If, however, the patient is to be operated on, it is better to have the patient in the hospital at least 2 weeks prior to the operation even if the preoperative medication and the preliminary studies have been accom-

plished in the out-patient clinic. The concurrent use of iodine and propylthiouracil seems to be a more effective preoperative treatment than either one alone in the more serious cases, unless the patient has a large thyroid gland. In the latter case Kyle (*10*) believes propylthiouracil alone is better. He also states that after 3 months of therapy with propylthiouracil the thyroid gland becomes less friable.

CONCLUSIONS

The study of hyperthyroidism in the Armed Forces should be encouraged, and a definite plan of action by the internist in conjunction with the surgeon should be outlined for each patient. Facilities in at least one central laboratory of the Armed Forces should be developed for the determination of protein-bound blood iodine levels to aid in the diagnosis of equivocal cases of thyroid gland disturbance.

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Extrusion of Redundant Gastric Mucosa into the Duodenum

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THE terms, herniated, prolapse, extrusion, and protrusion of the gastric mucosa have been used interchangeably for the pathological condition in which the gastric mucosa is found sliding through the pyloric ring into the duodenum. As pointed out by Norgore and Shuler (*1*), the term extrusion means "a pushing out or forcing out by expulsion"; and is probably as correct a description of the condition as any.

This condition occurs so frequently that it must always be considered as a possible etiologic factor in upper gastrointestinal complaints. In a review of the literature to date concerning this and related conditions there have been 54 cases reported with surgical confirmation of 27 cases. Previous authors have reported the following incidence of the condition found after routine gastrointestinal study. Rees (*2*) found 0.23 percent in approximately 5,000 examinations. Scott (*3*) found 1.04 percent in 1,342 routine examinations. Nygaard and Lewitan (*4*) reported 1.625 percent in 800 examinations. In the past 21 months at this hospital we found 30 cases or 2.88 percent in 1,073 successive routine gastrointestinal studies. It is believed that the cases reported here represent the largest single series confirmed by surgery.

Eliasen, Pendergrass, and Wright (*6*) in 1926 believed they were reporting the first 2 cases. However, it is now known that von Schmieden (*7*) had previously reported this condition in 1911. The largest series of surgically treated cases was reported by Scott (*3*) in 1946; 5 cases of 15 reported were operated upon. Rees (*2*) in 1937 reported 4 cases of which 3 were operated upon. Archer and Cooper (*8*) in 1939 reported 4 cases, all of which were proved at surgery. Pendergrass and Andrews (*9*) in 1935 reported 3 cases confirmed by surgery. The remaining reports are limited, concerning 1 or 2 operated cases.

ETIOLOGY AND PATHOLOGY

The underlying etiological factors in extrusion of the gastric mucosa through the pyloric ring are not definitely known. Several

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theories have been proposed. Eliasen and Wright (*10*) believe that it is a result of a local hypertrophy of the gastric mucosa following a low grade inflammation and that the hypertrophied folds are swept along through the pylorus by peristaltic action. Rees (*2*) advances the theory that narrowing of the pyloric lumen precedes the hypertrophy of the gastric mucosa. The narrowing of the pyloric ring causes hyperperistalsis of the stomach and in an effort to force the gastric contents through the opening, mobilization of the mucosa and gradual protrusion through the pyloric ring occurs. Scott (*3*) is of the opinion that neither of these theories is fully supported by his study. He found no roentgenologic, gastroscopic, operative, or pathologic evidence of gastritis. Neither did he believe that there was any evidence of a narrowing of the pyloric ring. In our series of nine cases in which surgery was performed, the pyloric ring was always palpated prior to section. In all instances the pyloric ring was believed to be constricted either by spasm or hypertrophy. In two instances, there was evidence of trauma to the hypertrophic mucosal folds from the constricted pyloric ring. One case visualized from the duodenal side revealed a rosette of red edematous gastric mucosa protruding through the pylorus, analogous to protruding hemorrhoids. There was no evidence of generalized gastritis, either gross or microscopic. It is, therefore, our opinion, that the underlying etiologic factor may be primarily either a spasticity or hypertrophy of the pyloric musculature. Comparative study of sections of the pyloric ring has not been done in our cases. Sections of the protruded gastric mucosa have been available since, in one case, a partial gastrectomy was performed and in five other cases the redundant mucosa was excised. Histologic examination showed a moderate lymphocytic infiltration of the submucosa but insufficient evidence to establish a diagnosis of chronic gastritis.

SYMPTOMS

The symptoms of extruded gastric mucosa are varied, often indefinite and vague, and the severity is undoubtedly dependent upon the degree of spasm. Several previously reported cases were first labeled as gastric neuroses. The complaints will, in general, fall into the following groups:

Epigastric pain or upper abdominal distress of some type was present in all cases. It varies as to severity and type. In some patients it may be only a discomfort or a feeling of fullness; in others it may be intermittent and cramplike and aggravated by the intake of solid food. It may be confused with an ulcer-type pain. This is particularly true in those relieved by a Sippy diet and antispasmodics. Many became

asymptomatic under an ulcer regime. Many had only partial relief of symptoms when on a soft diet and antispasmodics.

Abnormal sense of fullness after the consumption of a small amount of food is a very common symptom and was noted in a high percentage of our patients. In several this was the outstanding symptom. It may or may not be related to any particular type of food.

Vomiting is a frequent occurrence and is nearly always preceded by a sense of fullness. Several patients induced vomiting by gagging themselves for relief of discomfort.

Figure 1.—Considerable protrusion of redundant gastric mucosa, into the duodenal bulb, which responded to dietary management and antispasmodics and removal of disturbing emotional factors.

Figure 2. (Preoperative)—A minimal cauliflower defect in the bulb which was unrelieved by medication for 7 months.

Hemorrhage was reported as a common complication. It may appear only as intermittent occult blood in the stool. It has been reported, however, as acute episodes of profuse bleeding resulting in collapse. None of our patients had evidence of gross bleeding; they were not studied for occult bleeding.

Loss of weight was not an outstanding symptom. It was found in several patients who had limited their food intake because of discomfort. Interestingly enough, one patient in this series developed symp-

toms following a weight gain of 90 pounds after release from a Japanese prison.

Gaseous eructation was such a common symptom that study for gallbladder disease was nearly always done.

Figure 3. (Postoperative)—Normal appearance of stomach and duodenum after pyloroplasty.

Associated nervousness was frequently present. Many patients with extruded gastric mucosa were considered to have functional complaints.

The diagnosis of extrusion of the gastric mucosa of the stomach into the duodenum can at times be suspected from the clinical history. However, the establishment of the diagnosis must be made by radio-

graphic examination, but can easily be overlooked by the radiologist if he does not keep the entity in mind at all times. The filling defect due to extrusion of the gastric mucosa into the duodenal bulb is found at the base of the duodenal bulb immediately distal to the pyloric opening.

Figure 4.—Extreme prolapse of redundant gastric mucosa into the bulb producing a mushroom defect. Pyloroplasty with resection of the mucosa relieved all symptoms.

The protruding folds of hypertrophic mucosa form a "cauliflower" or "mushroom" appearing area of decreased density in the shadow of the duodenal bulb. This shadow of decreased density will vary noticeably in size and shape during an examination and at times may become

completely reduced and therefore will not be visualized. Usually, during the examination, there is slight tenderness elicited on palpation over the duodenal bulb.

Figure 5.—Extreme protrusion of redundant gastric mucosa into the bulb.

The differential diagnosis is not too difficult. The deformity produced by duodenal ulcer after healing is usually extremely irregular in appearance and usually involves portions of the duodenal bulb other than the base. Active duodenal ulcer will usually show a crater, ulcer niche, or incisura. An ulcer crater with radiating stellate lines creates a different appearance than the protruded gastric mucosa. The duodenal bulb in the case of ulcer usually empties quickly and is rather

spastic. In duodenitis, the bulb is spastic, very irritable, and empties rapidly; the mucosal pattern is coarse and irregular and the typical defect noted at the base of the duodenal bulb is not visualized. Small single folds of gastric mucosa which normally extend across the pylorus into the duodenal bulb are often visualized. This was pointed out by Scott (*3*) as being a normal variation and not an extrusion of the gastric mucosa. Figures 1, 2, 3, 4, and 5 are representative films from our series of nine cases.

TREATMENT

Many cases have been kept symptom-free under medical management. This is proof that the condition is certainly one that does not always require surgery. In a review of the cases reported it is evident that surgical treatment was not considered until medical management had failed.

In our opinion, a surgical procedure would not be indicated when the patient remains asymptomatic under a fairly limited medical regime. In some, however, the complete relief of symptoms requires strict adherence to a limited diet and the continuous use of antispasmodics. Often this is not only a great burden to the patient, but also incompatible with an active life. Surgery is certainly indicated in those with persistent pain, hemorrhage, or vomiting.

Various surgical procedures have been done for this condition. Ferguson (*5*) states that the treatment should be directed toward removing the prolapsed mucosa, short-circuiting the diseased area, or enlarging the pyloric outlet. In the cases reported this has been done by some type of pyloroplasty, by gastrojejunostomy, and, in a few cases, by partial gastrectomy.

Gastrojejunostomy has failed to relieve symptoms according to Nygaard and Lewitan (*4*) and Rees (*2*). This procedure is probably contra-indicated. Although it provides an unobstructed outlet for the stomach, it in no way would prevent a hypertrophic fold of mucosa from being swept through the pylorus.

A partial gastrectomy is a procedure which undoubtedly removes the pathologic condition, but it appears to be radical. Even though the morbidity and mortality for gastrectomy has, in recent years, been reduced to a minimum, it carries a greater risk than excision of the gastric mucosa and some type of pyloroplasty.

Eight of our patients have been treated by pyloroplasty. In six the redundant mucosa was also excised. In one patient, in whom there was evidence of a prepyloric ulcer, gastric resection was done. In all cases in which pyloroplasty was performed, the pylorus was inspected through a small incision on either the anterior surface of the stomach or the duodenum before sectioning the pyloric ring. Digital exami-

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nation revealed a narrowed pylorus in all cases with gastric mucosa protruding into the duodenum. Sections of the pylorus were not taken for biopsy and consequently we cannot definitely say whether or not the apparent narrowing of the pyloric ring was the result of hypertrophy or spasm. In those cases in which the mucosa was extremely redundant the mucosa was tented with an Allis forceps, freed from the underlying submucosa, and excised. The remaining free edge of the mucosa was sutured to the pyloric ring. In all cases the incision across the duodenum and stomach was sutured in a line opposite to the longitudinal incision, according to the procedure attributed to Mikulicz.

The immediate postoperative course in all cases was entirely uneventful. Wangensteen suction was maintained for 3 days and the patients rapidly progressed until they were on a full diet.

It is perhaps too early to evaluate the results, since our first case was done only 2 years ago. All the patients on whom surgery was performed have remained symptom-free on an unrestricted diet. All were active service personnel and returned to full duty status.

SUMMARY

Extrusion of the gastric mucosa occurs much more frequently than is commonly thought. Thirty instances were found in approximately 1,000 patients, and 9 cases were treated surgically with excellent results. The diagnosis should be suspected from the symptoms, but can be confirmed only by roentgen examination.

Surgery is indicated in those patients not responding to diet and antispasmodics. Excision of the extruded mucosa with pyloroplasty is probably the procedure of choice for this condition.

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Many deaths have occurred from the use of sulfa drugs. In 1941 New York City alone reported 28 known sulfonamide deaths. Many more were suspected.

Grollmann and Slaughter in 1947 estimated that there is one death in every 4,000 persons given chloroform anesthesia. They report that in properly hospitalized patients, receiving adequate medical and nursing care, there is 1 death in every 2,853 patients receiving sulfa drugs. * * * Bentley Philips reports that of 2,500 soldiers treated by dermatologists in several military hospitals for various skin diseases during the recent war 4.11 percent were found to be sulfonamide dermatitis. In no case did dermatitis occur when the patient had been treated for less than 4 days. Local application of the sulfonamide for a superficial skin condition was found in each case.

The suggestion is offered that we refrain from using sulfa drugs topically for insignificant skin lesions that will respond to other known medicinals that are not so prone to irritate or sensitize the patient. The plea is made that we not give sulfonamides systemically for minor ailments.

Gunshot Wounds in the 8th Air Force in World War II

JAMES A. RAFFERTY, *M. D.*[1]

ONE of the primary concerns of the surgeon of a combat unit has always been the treatment of wounds incurred in battle. Prior to 1900 the treatment of such wounds was almost the only duty of the military surgeon. Today military medicine embraces all the specialties of civilian medicine and such additional specialties as aviation medicine and medical logistics. The retention of the title "surgeon" for officers, regardless of their medical specialty, is a reminder of their origin. The following study of gunshot wounds was prepared from the records of the Bomber Command of the 8th Air Force, European Theater of Operations, January 1943 through June 1945. These records are unusually thorough and complete.

During the war the flight surgeon of each unit made out a weekly Care of Flyer Report and forwarded the report to the Office of the Air Surgeon in Washington, D. C. These reports were sequentially used for administrative decisions. After the war the reports were sent to the Department of Biometrics, School of Aviation Medicine, Randolph Field, Tex., for statistical analysis. Each item on each report was coded and a series of punch cards were prepared. Incidence rates were computed on the basis of weekly mean flying personnel strength. A number of special studies based on these data are available through the secretary of the school. Pertinent results on gunshot wounds are given in tables 1 and 2.

DISCUSSION

These tables do not show the importance of gunshot wounds as a factor in the loss of combat personnel. This information may be found elsewhere (*1*) (*2*). Gunshot wounds in this bomber command occurred at the rate of 90 cases per 1,000 men annually in the 2½-year period covered. One-fourth of these were permanently removed from flying duty for medical treatment. There were 700 missing or killed in action per 1,000 men annually in the same period. A large percent of the latter were the result of gunshot wounds of one sort or another, but the care of these casualties did not contribute to the workload of

[1] Chief, Department of Biometrics, Randolph Air Force Base, Tex.

the flight surgeons. Using these estimates and assuming that a man is on duty for an average of 6 months before he becomes a casualty, the noneffective rate caused by casualties was about 35 percent, and that caused by gunshot wounds was about 1 percent. All medical reasons, including gunshot wounds, amounted to 10 percent. Thus, the treatment of gunshot wounds was one-tenth of the total medical problem. It may be noted that head colds accounted for a noneffective rate of about 1 percent.

Table 1 shows trends for the 2½-year period of hostilities in the European Theater of Operations in regard to (*a*) the absolute magnitude of the occurrence of wounds (number of removals); (*b*) the relative magnitude of these occurrences (rate per 1,000 men annually); and (*c*) the nature of the wounds (percent distribution by type of missile). The number of removals for the second and third quarters of 1944 reflect the maximum in aerial combat effort associated with the Normandy invasion. The rate of gunshot injuries was high early in 1943 when our airmen were inexperienced, and again early in 1944 when the enemy was making a last stand for air supremacy. The superiority of Allied air power is evident in the data for late 1944 and early 1945. A notable shift in the type of missile

TABLE 1.—*Removals from flying status because of gunshot wounds, by quarters for the Bomber Command, 8th Air Force, January 1943–June 1945*

NUMBER OF REMOVALS

	1943				1944				1945	
	I	II	III	IV	I	II	III	IV	I	II
All missiles	110	246	380	411	627	1,055	1,080	651	602	117
Flak	26	76	161	190	376	778	923	551	508	74
Cannon shell	36	92	136	174	179	155	55	21	19	12
Secondary missile [1]	0	26	39	10	27	59	61	53	44	11
Machine gun bullet	3	31	42	29	27	39	16	12	11	5
Other [2]	45	21	2	8	18	24	25	14	20	15

RATE PER 1,000 MEAN FLYING STRENGTH PER ANNUM

All missiles	221	185	155	101	126	149	115	71	62	18
Flak	52	58	66	47	75	110	99	60	53	11
Cannon shell	72	70	55	43	36	22	6	2	2	2
Secondary missile [1]	0	20	16	2	5	8	7	6	5	2
Machine gun bullet	6	22	17	7	5	6	2	1	1	1
Other [2]	91	15	1	2	5	3	1	2	1	2

PERCENT

All missiles	100	100	100	100	100	100	100	100	100	100
Flak	23.6	30.9	42.3	46.3	60.0	73.7	85.5	84.7	84.4	63.2
Cannon shell	32.7	37.4	35.8	42.3	28.5	14.7	5.1	3.2	3.2	10.3
Secondary missile [1]	0	10.6	10.3	2.4	4.3	5.6	5.6	8.1	7.3	9.4
Machine gun bullet	2.7	12.6	11.1	7.1	4.3	3.7	1.5	1.8	1.8	4.3
Other [2]	41.0	8.5	.5	1.9	2.9	2.3	2.3	2.2	3.3	12.8

[1] Plane fragments and equipment, a gunshot being the underlying cause of the wound.
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PERCENT

All missiles	100	100	100	100	100	100	100	100	100	100
Flak	23.6	30.9	42.3	46.3	60.0	73.7	85.5	84.7	84.4	63.2
Cannon shell	32.7	37.4	35.8	42.3	28.5	14.7	5.1	3.2	3.2	10.3
Secondary missile [1]	0	10.6	10.3	2.4	4.3	5.6	5.6	8.1	7.3	9.4
Machine gun bullet	2.7	12.6	11.1	7.1	4.3	3.7	1.5	1.8	1.8	4.3
Other [2]	41.0	8.5	.5	1.9	2.9	2.3	2.3	2.2	3.3	12.8

[1] Plane fragments and equipment, a gunshot being the underlying cause of the wound.
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NOTE: High percent in "Other" early in 1943 probably attributable to incomplete reporting.

producing the gunshot wounds is depicted in table 1. The reduction in percent of cannon shell wounds and the increase in percent of flak wounds is a measure of the change from offensive to defensive operations on the part of the enemy. Readers with detailed historical knowledge may well differ with these interpretations, or may find further interesting historical explanations for minor fluctuations in the statistical results of table 1.

Surgeons actually concerned with the medical treatment of gunshot injuries want to know tthe types of surgical problems generated by gunshot wounds. Although no direct information in this regard is available in our study, certain indirect information is given in table 2. With reasonable medical inference, one can imagine the type of medical situations presented by a flak wound of the leg as opposed to a machine gun wound of the chest. The data in table 2, then, are relevant to the care and prevention of wounds. By perusing these data a surgeon can anticipate the types and proportions of surgical operations he would expect to perform under the combat conditions of the 8th Air Force. Moreover, the flight surgeon can study vulnerability and institute remedial measures.

In table 2, one notices that about 75 percent of the wounds occurred in the head and extremities. It would be interesting to compare this

TABLE 2.—*Removals from flying status because of gunshot wounds, according to site of injury, Bomber Command, 8th Air Force, January 1943–June 1945*

NUMBER OF REMOVALS

	All sites	Leg	Head and neck	Arm	Chest and shoulder	Buttock and hip	Abdomen	Back	Inguinal region [3]	Multiple sites
All missiles	5,279	1,656	1,124	966	385	153	69	64	20	842
Flak	3,663	1,272	657	744	288	119	42	54	13	474
Cannon shell	879	214	150	119	61	24	16	7	3	285
Secondary missile [1]	330	27	251	18	5	0	1	1	0	27
Machine gun bullet	215	70	34	34	20	9	8	2	1	37
Other [2]	192	73	32	51	11	1	2	0	3	19

PERCENT BY SITE

All missiles	100	31.4	21.3	18.3	7.3	2.9	1.3	1.2	0.4	15.9
Flak	100	34.8	17.9	20.3	7.9	3.2	1.1	1.5	.4	12.9
Cannon shell	100	24.4	17.1	13.5	6.9	2.7	1.8	.8	.3	32.5
Secondary missile [1]	100	8.2	76.0	5.5	1.5	0	.3	.3	0	8.2
Machine gun bullet	100	32.6	15.8	15.8	9.3	4.2	3.7	.9	.5	17.2
Other [2]	100	38.0	16.7	26.6	5.7	.5	1.0	0	1.6	9.9

PERCENT BY MISSILE

All missiles	100	100	100	100	100	100	100	100	100	100
Flak	69.3	76.9	58.6	77.0	74.8	77.7	60.9	84.6	65.0	56.3
Cannon shell	16.7	12.9	13.3	12.3	15.8	15.7	23.2	10.7	15.0	33.8
Secondary missile [1]	6.3	1.6	22.3	1.9	1.3	0	1.4	1.6	0	3.2
Machine gun bullet	4.1	4.2	3.0	3.5	5.2	5.9	11.6	3.1	5.0	4.4
Other [2]	3.6	4.4	2.8	5.3	2.9	.7	2.9	0	15.0	2.3

[1] Plane fragments and equipment, a gunshot being the underlying cause of the wound.
[2] Includes small arms fire, rocket shells, and "missile not reported."
[3] Includes inguinal and suprapubic regions and the groin.

figure with the percent of body area presented by these parts taking into consideration all directions of attack. The percent of exposure offered by the head and extremities should agree with the rate of occurrence of wounds in these sites. Such comparisons are useful in assessing the value of protective devices on or about various parts of the body. For example, during parts of the war, air crews wore flak suits, or trunk armor not unlike the bulletproof vests of gangsters. Assuming that the percent of exposure of the head and extremities is 60 percent in random three-dimensional gunshot attacks on a man in a sitting position,[1] the flak suit was valuable in preventing serious addominal and chest injuries. It should be further noted that the head and neck were hit by at least 76 percent of the slow velocity, secondary missiles (table 2). Clothing and armor were apparently sufficient to stop most of these missiles, only the face being exposed.

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[1] Determination of the percent of exposure is not simple. Minimal requirements include photographing from numerous directions, measuring areas, weighting for nonrandomness resulting from airplane structure, and averaging. It should also include three-dimensional mathematical analysis. The figure used here is a rough personal estimate based on 30 minutes' examination of a colleague sitting at his desk.

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Administration of Procaine Intravenously

III. In Traumatic Surgery[1]

REGINALD J. M. ZELUFF, *Captain, MC, U. S. A.*[2]

SINCE procaine is believed to act peripherally, crossing the permeable capillary membrane and bathing the terminal axone endings, its use in the treatment of traumatic injuries, burns, and other conditions in which the pain stimulus is superficial, seems almost specific. In the early part of the war Gordon (*1*) found that procaine could be used intravenously with excellent results in the care and treatment of burns, and that solutions of 0.1 and 0.2 percent procaine started as an infusion shortly before the change of surgical dressings and débridement provided adequate analgesia for these procedures even though no morphine or other agent was used. This analgesia lasted several hours so that the patients were able to rest comfortably. The use of procaine intravenously is not associated with the respiratory depression so frequently seen in deep sedation with morphine. Its possibilities as a valuable agent in the management of burned patients who have inhaled an irritating smoke or gas can, therefore, be readily appreciated.

Although Tovell (*2*) found procaine given intravenously to be excellent while changing the dressings in burned patients and while performing superficial débridement, he found it necessary to use pentothal or some other agent when an extensive débridement was performed. Fraser (*3*) has used a solution of pentothal-procaine intravenously in the treatment of postoperative pain. He mixed 0.5 gm. of pentothal and 0.5 to 1 gm. of procaine in 1,000 cc. of 5 percent *d*-glucose in water or saline solution and gave it as a continuous slow infusion. On a well-controlled postoperative recovery ward where adequate facilities are available, this might prove to be a valuable method of controlling severe postoperative pain and pain in severely burned patients.

In the treatment of traumatic injuries the primary objective is the elimination of pain, vasospasm, and edema. Procaine given intra-

[1] Parts I and II of this series were printed in the December 1949 issue of The Bulletin of the U. S. Army Medical Department.

[2] Brooke General Hospital, Fort Sam Houston, Tex.

venously is of great value in the management of these cases. The case reports of three patients recently treated in this manner are presented.

CASE REPORTS

Case 1.—A 32-year-old man was admitted following an airplane crash, with dislocation of the third and fourth cervical vertebrae, fracture of the lamina of the third cervical vertebra, dislocation of the left hip with fracture of the acetabulum, comminuted fracture of the left talus, lacerations of the scalp and hands, and a hemothorax on the right side. Continuous traction was applied to the head by Crutchfield tongs. Opiates did not relieve the pain except in doses that depressed the respirations to dangerous levels. Five hundred cubic centimeters of 0.2 percent solution of procaine were administered intravenously. Shortly after the infusion was started the patient stated that he was comfortable for the first time since entering the hospital. He subsequently received procaine two or three times daily with codeine administered only in the middle of the night. This was continued for 2 weeks with no narcotics administered during that period in the daytime.

Case 2.—A 26-year-old man incurred a gunshot wound of the left axilla that did not involve the axillary artery. While he was still under general anesthesia, a stellate ganglion block was performed on the affected side, using the anterior approach, resulting in good warming of the extremity. In an effort to prolong the effects of the block as well as to control postoperative pain, 500 cc. of 0.2 percent procaine were administered intravenously twice daily. It was found that the extremity was kept almost as warm by this means as with the stellate block. The amount of opiates required was definitely reduced.

Case 3.—A 24-year-old woman sustained a gunshot wound of the left ankle. Skin grafts had been applied but had broken down, and a valgus deformity developed. Six months after her injury under spinal anesthesia using 60 mg. of procaine, the ankle was manipulated (with some bleeding of the wound) and a plaster cast was applied. The anesthetic wore off after about 90 minutes, and the patient suffered a great deal of postoperative pain. Fifty milligrams of Demerol intravenously and 50 mg. intramuscularly were administered with relief of pain and the patient went to sleep. One hour later, the patient awoke and complained of severe pain in the ankle. There was no excessive swelling of the exposed portions of her toes and no cyanosis. Since it was not deemed desirable to repeat the narcotic so soon, 10 cc. of 1 percent procaine were injected at the rate of 2 cc. per minute. At no time did the patient exhibit any untoward neurogenic or circulatory reactions. When the injection was completed she stated the pain was beginning to leave her and that the lower portion of the affected extremity was growing numb. In 10 minutes she was able to sleep and remained comfortable for 2½ hours.

This case illustrates the use of procaine intravenously in a 1 percent solution. Although in this country we are taught to avoid injecting 1 or 2 percent procaine into a vein, the French inject 1 percent procaine intravenously in doses of 100 to 200 mg. (10 to 20 cc. of a 1 percent solution) over a period of 2 to 5 minutes for the same indications that we use solutions of 0.1 and 0.2 percent. The possibilities of this method should be investigated, for if the drug can be given in this manner with reasonable safety, it would be advantageous from

the standpoint of the amount of time saved and the promptness with which relief is obtained.

Procaine may also be given intravenously before reducing fractures, but reduction is usually not possible with this agent alone (*4*). After reduction, procaine is a valuable agent for controlling pain and aiding the physical therapist in getting a wider range of motion with less discomfort to the patient. In sprains with no roentgenologic evidence of fractures single infusions of procaine promptly reduce the pain and increase motility. In ruptured intervertebral disc, if the pain is caused by a mechanical factor, an infusion of procaine gives no relief from the pain. It may, therefore, be used as an aid in the differential diagnosis of low back pain. In myofascitis, the low back pain and spasm caused by inflammatory conditions respond well to this treatment. Relief usually lasts several hours. The average patient requires about two infusions daily for 2 or 3 days, then three infusions in a 2-week period. In traumatic arthritis and causalgias excellent results have been achieved by the use of this drug.

In urticaria associated with transfusion reactions, although procaine infusions will not always clear the rash, it usually will alleviate the itching and increase the comfort of the patient. Although procaine does not prevent death in immediately threatening or severe embolic syndromes, at least it causes instantaneous disappearance of pain, dyspnea, anxiety, and the sensation of impending disaster in most such cases (*5*). Knight (*6*) has used 10 mg. of procaine to each 25 mg. of pentothal intravenously for hiccups that not infrequently develop following upper abdominal operations. The author has used 2 or 3 cc. of 1 percent procaine intravenously with excellent results after hiccups have developed in the course of an operation. In acute thrombophlebitis the rapid relief from pain achieved by a lumbar sympathetic block is well appreciated. Procaine given intravenously prolongs the effect of the block as has been shown by repeated temperature checks.

In postoperative anuria caused by reflex inhibition, procaine infusion will block this reflex arc and overcome vasospasm and renal cortical ischemia which cause arrest of urinary excretion (*7*). One patient, anuric for 48 hours, with thrombosis of the abdominal aorta extending above both renal arteries (demonstrated at autopsy), excreted 1,500 cc. of urine in 24 hours after one infusion of 500 cc. of 0.2 percent procaine. McLachlin (*8*) has used a 0.2 percent solution of procaine administering 500 cc. in 60 to 90 minutes as a substitute for morphine postoperatively after subtotal gastrectomy, pyloroplasty, cholecystectomy, herniotomy, and lobectomy. Relief of pain lasted from 5 to 12 hours after infusion in some patients. When necessary the infusions were repeated every 3 hours. Frequently the pro-

caine outlasts morphine in relief of pain. As an example of some of the more radical procedures carried out with the use of this agent, Allen (*9*) reported a patient in whom a fractured hip was immobilized with pins using a total of 2.75 gm. of procaine intravenously in 77 minutes. The patient was able to assist himself in getting off the table. Another patient undergoing cholecystectomy was given 4.25 gm. of procaine intravenously in 1¾ hours but with imperfect muscular relaxation (*9*).

Procaine infusion is not a panacea for the relief of pain, but if judiciously employed is a useful agent.

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Bronchiectasis

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BRONCHIECTASIS is a dilatation of the bronchi secondary to pathologic changes within their walls. It is primarily a disease of the branch bronchi and is often limited to one or more segments of a lobe.

ETIOLOGY

Antecedent infections such as primary pneumonia, measles, whooping cough, scarlet fever, influenza, or infection associated with aspiration of foreign bodies are found in the majority of cases. Although the literature on etiologic factors is abundant, an excellent review of the subject is the monograph by Lisa and Rosenblatt (*1*).

The lower lobes of the right or left lung are involved in the great majority of cases. The incidence, based upon autopsy findings and clinical observations, is about 30 to 1 for the lower lobes over the upper lobes. It occurs unilaterally in about two-thirds of the cases, and is usually limited to one lobe or to one lobe and a portion of another lobe. The lingula of the left upper lobe is frequently involved, particularly when bronchiectasis is present in the lower lobe of the left lung.

The incidence of bronchiectasis at autopsy varies from 0.4 to 5 percent, however, the statistics vary with the type of service reporting. In a large pediatric service the incidence of bronchiectasis will be much higher than in a hospital devoted to treatment of older persons.

There is a slightly higher incidence in men.

The majority of reports indicate that the condition begins in childhood and adolescence and that most patients with the disease do not live to reach the older age groups. It is predominantly a disease of youth.

There are four main theories of the cause of bronchiectasis:

(*a*) *Neuromuscular theory.*—This assumes that an inflammatory process within the bronchial wall results in a destruction of the nerve supply with subsequent paralysis of the muscle.

(*b*) *Intrabronchial pressure theory.*—Most workers in physiology believe that there is a great difference between the intrabronchial and

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intrapleural pressures. The chief causes for weakening of the bronchial wall are atelectasis of the adjacent lung parenchyma and infection of the bronchial wall; atelectasis results in a relative increase in intrabronchial pressure; the bronchi are weakened because of inflammation and loss of the external support.

(*c*) *Fibrous retraction theory.*—This theory presupposes that bronchial dilatation is due to the traction of adjacent fibrous tissue. This is based on the finding of irregular retraction within the bronchial lumen which occurs where fibrous tissue is abundant.

(*d*) *Ball-valve mechanism theory.*—This theory assumes a ball-valve mechanism is present, and on expiration the air escapes more slowly thereby increasing the intrabronchial pressure.

The most widely accepted theory is that the obstruction, whether mechanical due to a foreign body or new growth, or due to other factors, gives rise to stagnant secretions and results in anoxia. This favors the growth of bacteria and concomitant inflammatory reaction of the bronchial wall.

PATHOLOGY

In the early stages, bronchiectasis is characterized by inflammation; the mucosa is red and velvety in appearance and the bronchial wall is thickened and soft. In most instances the surrounding lung parenchyma is involved in a pneumonic process but areas of abscess formation may also be present. In the intermediate stage the dilated bronchi extend to the peripheral portion of the lung parenchyma and to the visceral pleura and the mucosa appears smooth and gray. In the final stage of bronchiectasis, one or more segments of lung parenchyma contain cylindrically or saccularly dilated bronchi, the walls of which are lined with a smooth, gray membrane; extensive peribronchial connective tissue infiltration occurs. The areas of connective tissues extend from the periphery of the walls of the bronchi into the surrounding lung parenchyma.

The basic change within the wall of the bronchi is that of an acute inflammatory process. At first there is an invasion of the wall of the bronchus by polymorphonuclear leukocytes, fibrin, serum, and red blood cells. The next change is the exfoliation of the epithelium into the lumen of the bronchi; as the inflammation progresses within the wall a progressive desquamation of the epithelial lining occurs. During the acute inflammatory process areas of necrosis may involve the elastic fibers and the muscle bundles. Pressure atrophy of the mucous glands occurs. Subsequently, healing sets in with the appearance of fibroblasts, lymphocytes, collagen fibrils, and dilated capillaries, and the inflammatory process is gradually replaced by a reparative process.

This granulation tissue replaces nerve fibers, mucous glands, muscle tissue, and even cartilage.

If the inflammatory and reparative processes are uniform in all directions then the dilation will be uniform: cylindrical bronchiectasis. If, on the other hand, all the wall is not evenly involved, and parts of the wall remain intact, then the dilation appears in circumscribed areas: saccular bronchiectasis.

The bacteriologic finding in the acute case is different from that of long-standing disease. In the acute case streptococci, pneumonococci, and staphylococci are ordinarily present if bronchopneumonia is found. In the chronic case, secondary invaders, the fusiform bacilli, spirochetes, various types of staphylococcus, and many other organisms are present; these were formerly thought to be the primary cause of bronchiectasis.

DIAGNOSIS

The correct diagnosis depends upon: (*a*) clinical history; (*b*) physical findings; (*c*) laboratory findings, especially the sputum examinations; (*d*) roentgenograms and fluoroscopy; (*e*) bronchoscopy; and (*f*) bronchography.

The clinical history usually is indicative of disease in the chest and points to the possible diagnosis. This is easy when there is a history of chronic cough beginning in childhood and aggravated by exercise, laughing, or on change of position, especially on arising in the morning. A history of repeated chest colds or pneumonia is suggestive. In the presence of chronic cough bronchiectasis must be considered (*2*).

Cough is the outstanding symptom in bronchiectasis. It may be severe, hacking, or persistent and is usually more severe in the morning and aggravated by anything which causes sudden movement of the lung.

Sputum may or may not be foul (only two of our cases had foul sputum); it is usually purulent but may be greenish or blood-streaked. At times the odor of the sputum is so foul and fetid, that the patient is shunned.

Hemoptysis is a prominent point in the history of bronchiectasis as it is commonly present in this disease. A patient who may have been coughing for years will seek medical advice when he sees blood in his sputum.

Dyspnea is usually not a prominent feature of the disease except in the very late stages. However, dyspnea may follow the coughing spasms which occur after exertion.

Additional symptoms.—Fever occurs when there is poor drainage or when pneumonitis occurred. Gastrointestinal symptoms may follow long bouts of severe coughing. Mild joint pains are occasionally noted and toxic dermatitis has been recorded. General consti-

tutional symptoms such as fatigue and loss of weight may be present. In the severe and long-standing case, right heart failure finally occurs.

PHYSICAL AND LABORATORY FINDINGS

The physical findings are frequently minimal, but some abnormal signs can usually be elicited. If bronchiectasis is suspected, auscultation should be done several times a day, and at some time râles may be heard. The râles are usually subcrepitant in character and may be accompanied by rhonchi. The majority of our cases revealed only sonorous or crepitant râles. Dullness to percussion, bronchial breath sounds, and bronchophony may be present over consolidated or organized lung segments. In general the signs depend upon associated parenchymal changes and upon the bronchial content at the time of the chest examination.

In addition to the chest findings, the physical examination may reveal chronic infection of the upper respiratory passages, such as sinusitis or chronic nasopharyngitis. When sinusitis is present the maxillary sinuses are usually involved. Clubbing of the fingers is a classic finding in bronchiectasis. The mechanism of its production is obscure, but a logical explanation has recently been offered by Mauer (*6*). Lisa and Rosenblatt (*1*) in their monograph on bronchiectasis state that "* * * there is no direct relationship between the extent or duration of the bronchiectasis and the incidence of clubbing." In our series, a group of relatively young adults, the patients had had the disease only a relatively short period of time; we found clubbing in only one case. When clubbing is present there are usually other signs which facilitate the diagnosis.

Sputum studies.—These are of little value in diagnosing bronchiectasis. Bacteriologic cultures of the sputum aid only in choosing the antibiotic suitable for treatment of the acute episodes. Tuberculosis can be eliminated by bacteriologic studies of the sputum; it should be done routinely in every suspected case of bronchiectasis.

Roentgenograms.—The routine chest roentgenogram may suggest bronchiectasis when accentuated hilar marking of the affected side and increased markings extending into the midportions and bases of the lungs are noted. The linear bands, separated by columns of air, ending in club-shaped densities, and the annular shadows described by Andrus (*3*) were not as frequently associated with bronchiectasis, in our experience, as was invariably present in his cases. Triangular shadows noted in the lower lobes may represent an atelectatic or fibrotic portion of a lobe as a result of bronchiectasis. In our experience one of the best indications of bronchiectasis is delayed resolution of pneumonia or pneumonitis which occurs during a brief (2 or 3 days) illness.

Bronchogram.—This is the final diagnostic procedure; it demonstrates the disease, and must be done if surgical therapy is contemplated. The technique is well described in many textbooks and will not be discussed. However, one point needs emphasis: the bronchi should be drained before bronchograms are attempted. This can be done by postural drainage, bronchoscopic aspiration, or by exercises.

Bronchograms should not be done unless bronchiectasis is suggested by the history and physical examination. In pulmonary tuberculosis, many believe that the lipiodol can cause spread of the disease. In inflammatory or neoplastic disease, the progress of the disease is obscured by the presence of lipiodol in the peripheral bronchi.

Bronchoscopy.—This procedure must always be done in any case of suspected bronchiectasis. This is done preferably before bronchography. Occasionally this procedure will eliminate or demonstrate intrabronchial lesions, neoplasms, or foreign bodies to which the bronchiectasis may be a sequela.

SURGICAL TREATMENT

The operative treatment of bronchiectasis has undergone many changes and improvements, but it was not until lobectomy was introduced that hope for cure could be expected. The operative mortality for lobectomy has been reduced from about 60 percent reported as late as 1925, to the present mortality of less than 5 percent. With the low mortality rate, operative treatment can be recommended to nearly all patients with bronchiectasis.

The question naturally arises as to why a patient with a chronic nonmalignant disease should be subjected to an operation that has a mortality rate of about 5 percent. Perry and King (*7*) in 1940, studied 211 cases and Bradshaw, Putney, and Clerf (*8*) studied 171 cases of bronchiectasis under medical treatment; the former found that 24 percent died as a direct result of the disease and the latter found 34.5 percent who died from the disease or its complications. The average duration of life after the onset of symptoms was 13½ years, and from the date of diagnosis the average was 1.8 years. These two studies show the advantage of operative removal of the diseased segments.

Prior to 1922, when the use of radiopaque oil for outlining the bronchial tree was introduced by Sicard and Forestier (*9*), the accurate localization of the disease was difficult. At the present time the diseased segments can be accurately localized and the amount of lung tissue to be removed accurately determined before operation.

Preoperative care.—The aims of preoperative care as noted by Maier (*10*) are: (*a*) to decrease bronchial and parenchymal inflammation; (*b*) to decrease bronchial secretions; (*c*) to decrease virulence and number of existing bacteria; and (*d*) to improve the patient's general

condition. The routine we follow is based on these principals. An adequate diet is given as indicated by the patient's general condition, and vitamins are prescribed to assure an adequate reserve for the immediate postoperative period. If there is anemia, he is given necessary blood transfusions preoperatively as well as 1,500 cc. whole blood on the day of operation. Postural drainage is done every 3 to 4 hours during the week prior to operation and, in some, moderate exercise is advised to promote coughing. Penicillin aerosol inhalation is prescribed 1 week before and by injection 3 days before operation.

Operation.—With the side to be operated upon uppermost and the arm held forward in order to slightly elevate the scapula, a posteriolateral incision is made below the angle of the scapula. The posterior two-thirds of the seventh rib is removed when only the lower lobe is involved, and the sixth rib when the lingula or middle lobe is to be resected. When only the middle lobe is resected, an anterolateral intercostal incision is occasionally used.

The operative procedure followed in the segmental resection, when divisions such as basal division of either side or lingula are to be removed, is fairly well standardized except for minor modifications. The interlobar fissure is dissected down to the hilum. The pulmonary artery and branches to the segments involved are identified, doubly ligated with black silk, and divided.

To approach the veins, the lobes of the lung are all reflected anteriorly and the posterior aspect of the hilum dissected. The upper lobe veins drain into the superior pulmonary vein while the lower lobe veins are tributaries of the inferior pulmonary vein; the veins of the middle lobe on the right and the lingula on the left drain into the superior pulmonary vein. The superior and inferior pulmonary veins usually empty separately into the left auricle. The tributory from the division to be removed is identified by its position of entrance into one of the main pulmonary veins and its course in the lung. The vein is then doubly ligated and sectioned between ligatures.

The bronchus to the portion of the lung to be removed is now fairly free of surrounding tissue. Through and through ligatures are placed on either side of the bronchus approximately one-eighth of an inch from its junction with the main bronchus and tied. A clamp is then placed distal to the ligatures and the bronchus is transected. Tension on the long ends of the ligatures keeps the bronchial walls approximated until an aspirator is introduced into the open end of the bronchus to aspirate any secretions in this area. The cut end of the bronchus is then closed with closely placed interrupted sutures of black silk or fine cotton.

To resect individual segments is sometimes a more difficult problem but to resect the basal division when, for instance, only the posterior

segment of the basalar division is involved is an unnecessary sacrifice of functional nondiseased lung tissue. The method used in such cases is to dissect carefully and to isolate the bronchus to the involved segment; the bronchus is then sectioned and the proximal end closed as noted previously. The artery and vein to the segment involved are not definitely identified or ligated at this time. Traction is placed on the distal end of the bronchus and by blunt dissection, using the fingers as suggested by Clagett and Deterling (*11*) in their technique for lingulectomy, the hilar portion of the segment is freed. It is found after this that the artery and vein to this segment are well-dissected and free to be ligated without fear of ligating the wrong vessel. When the artery and vein are sectioned, the remainder of the segment can be removed by blunt dissection. There may be several small intersegmental vessels which require individual ligation.

When the involved segments have been removed the closure of the bronchus may be tested by placing normal saline solution in the thoracic cavity to above the level of the bronchus while positive pressure is maintained in the bronchial tree.

Intercostal catheters are then placed in the pleural cavity. One catheter is usually placed low and slightly posterior to remove any fluid accumulation. The second catheter is placed above and anteriorly to suck out air and aid in the reexpansion of the lung. In the wound closure, the pleura and the periosteum of the removed rib are approximated with care to avoid injury to the intercostal nerve and vessels. The catheters are attached to a two-bottle water seal with constant suction and a minimum of 10 to 12 cm. negative water pressure maintained.

Immediate bronchoscopic aspiration while the patient is on the operating table is carried out on all patients with bilateral disease and whenever there is any suggestion of accumulation of secretions in the bronchi.

POSTOPERATIVE CARE

Penicillin is administered until the chest is free of fluid and the temperature has been normal for 3 days. Oxygen is used as indicated. The tubes are removed when the lung is completely reexpanded. Fluid which may accumulate after the removal of the tubes is aspirated by needle. Penicillin has been used intrapleurally after the removal of the fluid.

The patient is encouraged to cough following operation; this is one of the most important points in postoperative care. It prevents atelectasis in the remaining segments which might occur if the thick secretions were allowed to remain. Clagett (*11*) reported that 47 percent of his patients developed atelectasis of the left upper lobe following lingulectomy.

Intratracheal aspiration (Haight technique) in the immediate postoperative period using a fairly stiff urethral catheter has been of great value in preventing atelectasis and has been the instrument used in reexpanding at least four lungs in patients with roentgenographic as well as clinical signs and symptoms of atelectasis. No bronchoscopic examination was necessary in these cases.

Method.—The patient is placed either sitting up or lying on his back, with chin elevated as high as possible. The sterile, stiff catheter is introduced through the nostril to the back of the throat. The patient is asked to say "E" several times in order to know its sound and then while the patient coughs the catheter is advanced. There is a definite feeling of free motion as it enters the trachea. If the patient is asked to say "E" now, the difference in sound is immediately apparent because the catheter is between the cords. The catheter may be connected with suction and moved up and down in the trachea. This stimulus to cough is the important part and even if suction is not available the results are good. This method has a very definite advantage in that it can be taught to the nurses in attendance. It is used at frequent intervals, as often as once each hour on occasions.

RESULTS

We have done 28 operations for bronchiectasis on 23 patients from June 1947 to January 1949. No deaths occurred. All patients except two with bilateral disease were greatly improved as shown by decrease in sputum. Coughing in all patients was lessened, but it was the one symptom which persisted longest after the removal of the diseased segments. Bilateral operations were done in 4 cases.

Portions of lung resected in our series were: right upper lobe, 2; right middle lobe, 6; apex of right lower, 3; basal of right lower, 10; right lower, 1; entire left lung, 1; left upper lobe (apical), 2; lingula, 6; apex of left lower, 1; basal of left lower, 10; and left lower lobe, 1.

In one case the middle lobe and medial and posterior basal segments of the lower lobe on the right side and medial segment of the lingula along with basal segments of the lower lobe on the left were removed. Pneumonectomy was done in one case and either segmental resection or lobectomy was done in the others.

COMPLICATIONS

Localized and loculated empyema with bronchopleural fistula occurred in four patients; one resulted from the removal of a shell fragment at the time of segmental resection. Three responded rapidly to a short period of intercostal tube drainage. One had a prolonged expectoration of foul sputum. None required reoperation.

Atelectasis of the remainder of lung on the left following removal of basal division and medial segments of the lingula occurred in one patient. This improved rapidly following bronchoscopic aspiration. Spontaneous pneumothorax on the seventh postoperative day with collapse of remainder of lung occurred in one patient. However, the lung reexpanded rapidly with intercostal tube suction. One patient required prolonged suction in order to reexpand the remaining lung.

In one patient because of inadequate localization preoperatively, insufficient segments were removed (as shown on postoperative bronchograms). He has since returned to the hospital stating that he was much improved but continued to have considerable sputum. Reoperation was necessary to remove the remaining diseased lung tissue. This case is an example of operating on a patient without first accurately localizing all the segments in the lobe to be operated on. This is one of the dangers of segmental resection. If there is any doubt repeat bronchograms should be done.

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Stevens-Johnson Disease

Report of a Case

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THE first description of the erythemas as a group is attributed to Willan and Bateman in 1808. Since then the large group of erythema multiforme has undergone many subdivisions. As far back as 1822 Alibert and Bazin (*1*) described the combination of severe systemic symptoms with the cutaneous lesions of erythema multiforme and involvement of the mucous membranes. In 1866 Von Hebra (*2*), in his original description of erythema multiforme bullosa, mentioned cases with severe ocular and conjunctival involvement but without severe systemic reaction. In 1916 Rendu (*3*) described a syndrome characterized by inflammation of the nasal, oral, pharyngeal, and anal mucosae and associated balanitis. Stevens and Johnson (*4*) in 1922 described what they called a new eruptive fever which was associated with stomatitis and ophthalmia.

A review of the literature shows that the disease which has become known as Stevens-Johnson disease is a combination of the various syndromes described by these authors and others. In all probability, it would be better termed Stevens-Johnson syndrome, a variety of erythema multiforme. This syndrome or disease has been reported under a variety of headings including: erythema multiforme with orificial lesions and systemic manifestations (*5*); erythema multiforme bullosa; erythema multiforme exudativum (*2*); ectodermosa erosiva pleuriorificalis (*3*); and severe erythema multiforme (*6*).

Essentially, Stevens-Johnson syndrome is a severe systemic disease characterized by ophthalmia, stomatitis, and erythema multiforme lesions of any or all mucous membranes, and the skin; in most cases concentrated in the periorificial areas. These lesions generally follow the stomatitis and ophthalmia in 24 to 72 hours. They may be macular, papular, vesicular, bullous, hemorrhagic, or a combination of these. A broad outline such as this is needed to include all the cases classified as Stevens-Johnson syndrome.

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The onset is often characterized by the insidious onset of stomatitis and ophthalmia followed by a severe systemic reaction and the eruptions previously described, but it may be abrupt. Cases are reported preceded by a variety of situations including pharyngitis (*7*), the ingestion of various drugs (*7*), severe toothache (*8*), Vincent's angina (*9*), chronic dermatitis (*10*), and the desensitization to caseinogen (*11*). The manifestations are protean in nature. The temperatures reported vary from low grade to high elevations. The patients' complaints vary from a slight headache to extreme prostration. The eye involvement has been divided into three main groups by Duke-Elder (*12*): catarrhal conjunctivitis; purulent conjunctivitis; and membranous conjunctivitis. Cases with membranous conjunctivitis are often followed by chronic conjunctivitis. The purulent conjunctivitis is the most severe and may be followed by severe complications such as corneal perforation or panophthalmitis. The involvement of the oral mucous membrane is, with that of the eyes, the most dramatic part of the picture. This may appear as a simple or severe stomatitis, or the involvement may extend down into the oral pharynx or even the tracheobronchial tree. The stomatitis has been reported severe enough to require parenteral feedings for a period of 3 days (*5*). The lesions in the mouth, and if present, in the pharynx or tracheobronchial tree (*13*), are generally vesicles which ulcerate and then crust or form a membrane.

The lesions of the skin are of any of a variety of types as previously mentioned. The lesions start as erythematous macules. These are of the iris type. They may proceed to vesicle or bullae formation and occasionally become hemorrhagic. The periorificial concentration of the lesions is often dramatic. The tendency to ulceration may lead to membrane formation over the urethra or rectum, and, occasionally, to the formation of synechia. Urethritis and balanitis are evidence of further involvement of the mucous membrane. A case has been reported with involvement around the fingernails resulting in loss of the nails (*14*).

The gastrointestinal tract (*4*) (*7*), the genito-urinary tract (*7*), and the mediastinum (*15*) have been incriminated by the disease process. Lymphadenopathy is a common finding. Splenomegaly is rare. Roentgenograms of the chest frequently show increased peribronchial and perivascular markings. Pneumonia is not uncommon (*16*). Positive electrocardiogram findings are reported but are probably secondary to the toxemia. The blood counts reported vary from a leukopenia (*17*) to a leukemoid reaction (*5*). Eosinophilia is an occasional, but by no means constant, finding. It is of interest to note that while eosinophilia is common in the more chronic allergic conditions, it is infrequent in acute allergic conditions (*18*).

The syndrome occurs most commonly in the spring and fall. It is more common in the European countries than on this continent. Young men are most often affected but cases are reported in infants of 4 weeks (*19*) and 1 year (*20*), and 1 case in a man 52 years of age (*21*). The proportion of men to women is about 5 to 1.

The syndrome runs a course apparently unaffected by any therapeutic measures. The duration depends on the severity of the individual case. Most often the systemic manifestations and mucosal lesions clear at about the end of the second week and the residual skin lesions clear about 1 week later. One case reported by Fletcher and Harris (*21*) lasted only 5 days, while a case reported by Kove (*22*) lasted 86 days, so theer is as great a variation in the duration of the syndrome as there is in its manifestations. Recurrences are common.

The cause remains obscure. The protean nature of the disease is very prominent. Whether it is an allergic or anaphylactic reaction to a viral or bacterial infection or other antigen, or if it is actually the manifestation of a widespread systemic infection is in the realm of conjecture. However, the disease presents what we would term an allergic picture with the antigen-antibody reaction unknown. The finding of Vincent's organisms in several cases led to attempts to incriminate these organisms but they could not be found in a significant number of cases. Cultures of the eyes, skin, and mucosal lesions have revealed nothing more than normal flora and the common secondary invaders. The possibility of a viral cause has not been eliminated but the work of the Commission on Acute Respiratory Diseases adequately eliminated the viruses of herpes simplex, vesicular stomatitis, and members of the psittacosis meningopneumonia group (*16*). Ritter and his group (*5*) failed to demonstrate the virus of vaccinia or herpes simplex which would exclude these as the causative agent in their case. As previously mentioned, a multitude of variegated precursors to the onset of the syndrome have been reported which will not fit into any definite causal pattern.

The complications following the syndrome hinge in most instances on the severity of the eye involvement. Prior to the advent of the antibiotics, as many as 50 percent of the cases terminated in blindness (*23*) (*8*). Other eye complications reported include: symblepharon; conjunctival and/or corneal scarring; perforation of the cornea; and chronic conjunctivitis.

Murphy (*24*) reported a case in which the glans penis sloughed. Four fatal cases have been reported. Two cases were reported that developed tuberculosis (*25*); one case developed rheumatic fever within 6 months after clearing of the skin lesions (*8*).

The treatment is entirely symptomatic, supportive, and preventive. The patient must be maintained in the best possible state of nutrition

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and hydration by proper use of parenteral fluids, blood, plasma, and such feedings as can be tolerated by mouth. Specially prepared liquid feeding similar to those used in tube feeding, but more palatable, are of particular value. Every effort must be made to prevent further infection of any of the ulcerated areas. The eyes should be under the care of a competent ophthalmologist if the involvement is severe. If an ophthalmologist is not available the pupils should be kept dilated and penicillin applied locally as an ointment or as drops (5,000 units per cc.), depending on the type of lesion, every 3 hours. The eyes should be kept clean with flushings of boric acid. Dark glasses will add to the comfort of the patient. Penicillin should be given intramuscularly in massive doses every 3 hours.

This general regime has resulted in a definite decrease in the incidence of complications reported. Of 21 cases treated with penicillin and/or sulfadiazine, none resulted in blindness (*5*) (*23*) (*7*) (*17*) (*8*). Three had corneal scarring and one a slough of the glans penis. Schoemperlen (*26*) reported 1 case treated with Benadryl which ran a very benign course, but it is impossible to evaluate any form of treatment in a disease as inconsistent as this, on the results of a single case.

A case characterized by high fever and a leukemoid reaction is reported. The authors believe that the progress of this case was favorably affected by the antihistaminic drugs and that severe complications were averted by the use of antibiotics.

CASE REPORT

S. C., a 5-year old girl, was well until about 3 weeks before admission when she apparently was bitten by red ants and developed a severe urticarial reaction around each bite which subsided after several days with no adverse results. Otherwise her past and family history were noncontributory.

The present illness began with a cold which improved before admission. On 25 December 1948 the child developed anorexia and general malaise and had a temperature of 102° F. The following day she complained of pain in her neck, and was unable to turn it from side to side. Her parents then noticed bilateral tumors on the posterior lateral aspect of the neck. The temperature remained between 102° and 103° F. She was seen at the hospital emergency ward with complaints of a sore throat, headache, and a painful neck for which she was given penicillin. The next morning, at the clinic, the patient presented the positive physical findings of bilateral tender tumor masses of the posterior cervical nodes with erythema of overlaying skin. The physical examination was otherwise negative and her general appearance was good. She presented what appeared to be a typical severe posterior cervical adenitis and was admitted to the hospital for intensive penicillin therapy.

On admission, 27 December 1948, her temperature was 102.6° F.; pulse, 128; respirations, 26; red blood cell count, 4 million; hemoglobin, 12 gm.; white blood cell count, 24,000, differential; 2 percent juveniles, 22 percent band forms, 68 percent segmented forms, 4 percent lymphocytes, 3 percent basophils, and 1 percent monocytes; urinalysis, negative; and blood culture taken on admission

revealed no organisms after 21 days. Penicillin, 50,000 units every 3 hours, and elixir of phenobarbital was started. That night the temperature rose to 104.8° F.; this was treated with alcohol sponges and ice water enemas which lowered the temperature to 101.5° F.

On the second hospital day, temperature was 105° F. at 6 a. m. Intravenous fluids, 1,000 cc. 5 percent *d*-glucose in normal saline was given and the temperature fell to 100° but later was again 105.8° F. There were no further changes in the patient's condition except that she developed bilateral nonpurulent conjunctivitis. Sulfadiazine was started at this time due to the poor response to penicillin. The child did not appear as acutely ill as the clinical findings indicated.

On the third hospital day, a red erythematous macular rash was observed around the navel, pubis, vagina, rectum, and on the palms and back. There was a mild stomatitis. Temperature remained between 103° and 105° F. A presumptive diagnosis of Stevens-Johnson disease was made, and the patient was started on Benadryl. Sulfadiazine was discontinued as there had been no clinical response after 24 hours. Fluid balance was maintained throughout by the administration of whole blood, intravenous fluids, and hypodermoclysis. Hyaluronidase was used to increase the absorption of subcutaneous fluids. By the afternoon of the third day the child had developed short periods of disorientation and was complaining of joint pain in her ankles and toes. The erythematous eruptions on the hands and body had become more extensive and confluent. Aureomycin was introduced empirically, 250 mg. every 6 hours. The red blood cell count was 4,200,000; hemoglobin, 12.5 gm.; white blood cell count, 24,500; differential, 1 percent juveniles, 9 percent band forms, 75 percent segmented forms; 13 percent lymphocytes, and 1 percent monocytes; many toxic granules were noted in the polymorphonuclear white cells; Weil-Felix heterophiles, Brucellosis, typhoid, and OX19 agglutinations were all negative.

On the fourth hospital day there was no appreciable change in the physical findings. The eruption seemed more intense in color although no vesiculations were present. The child began to complain of headaches and pain in the lower extremities. No edema or redness of the lower extremities were noted but there was marked tenderness and pain on motion of the ankles. Roentgenogram of the chest showed slight cardiac enlargement and increase in central vascular markings. There was no change in treatment.

On the fifth hospital day the rash was fading; there was no fluctuation of the posterior cervical glands. Mild stomatitis and moderate conjunctivitis were still present. The pain in the lower extremities was more pronounced. The temperature varied between 103° and 105° F. and more frequent periods of disorientation were observed. However, the child still did not appear to be as acutely ill as warranted by the clinical findings. On physical examination there were moist râles over both bases; pulse considerably elevated; temperature 105° F.; and respirations, 40, with slight cyanosis. It was thought that cardiac failure was imminent and that the patient was acidotic. One-sixth molar sodium lactate was given by clysis and she was placed in an oxygen tent. Streptomycin was begun because of the failure of the cervical adenitis to respond to any of the antibiotics and because of the seriousness of the illness. Benadryl was discontinued and Histadyl was substituted as it was thought that the disorientation might have been caused by Benadryl toxicity.

On the sixth hospital day, the rash had almost completely disappeared; however, she continued to complain of severe joint pain; sodium salicylate was started. The streptomycin was discontinued after a 72-hour trial. There was

no exacerbation of symptoms after withdrawal of the streptomycin and we do not believe that it was a factor in the patient's recovery.

About 2 a. m. on the seventh hospital day, the patient had a severe transfusion reaction following the administration of 350 cc. whole citrated blood. This reaction was the anaphylactoid type; the lips, eyes, and hands became extremely edematous; an erythmatous macular rash developed over the face, hands, trunk, and extremities; the child complained of a burning sensation in these areas; and the respirations became very shallow and rapid. Adrenalin was given with dramatic response. A few hours later the first signs of recovery were noted. There was a steady decline in temperature; the posterior cervical nodes diminished in size and the tenderness subsided; and there was slight improvement in the joint symptoms. Sodium salicylate was believed to be ineffective and was discontinued; there was no exacerbation of the symptom complex following this.

On the eighth hospital day the temperature ranged from 100.8 to 102° F. She appeared much improved and became more active and playful. All medications except the penicillin were discontinued. The child continued to show marked improvement on the ninth and tenth hospital days with decrease in size and tenderness of the posterior cervical nodes and the joint pains subsided. On the twelfth day penicillin was discontinued. The patient was discharged on the sixteenth hospital day; the only sequelae noted were mild residual joint pain in both ankles and faint discoloration of the skin where the eruption had been. The agglutination reactions for brucellosis, typhoid, paratyphoid A and B, Weil-Felix, and Proteus OX19 were again reported negative.

The patient was seen 1 week later and showed no abnormality except for slight stiffness of the ankles. Roentgenogram of the chest showed normal heart size and bronchovascular markings; physical examination was negative; the blood count was normal; and the Vollmer patch test was negative. A week of heat and hydrotherapy resulted in clearing the residual ankle stiffness. The patient will be followed for evidence of recurrence or the appearance of rheumatic fever or tuberculosis.

DISCUSSION

This case presented the symptom triad of a systemic disease with conjunctivitis, stomatitis, and erythema multiforme with outstanding perirectal, perivaginal, and periumbilical involvement. The significance of the early cervical adenitis cannot be definitely established. The unusual febrile reaction showed no response to any of the therapeutic measures instigated. The leukemoid reaction seen in the peripheral blood was extreme and the presence of large numbers of cells with toxic granules was an indication of the severity of the systemic reaction. The anaphylactoid reaction (which responded to adrenalin) of this patient to a blood transfusion is evidence to support an extreme allergic diathesis. The development of a noninflammatory arthritis may have been caused by a reaction in the synovial membrane similar to that in the skin or mucous membranes elsewhere.

It is believed that the entire picture presented by this patient was one of antigen-antibody reaction. Whether the etiological agent of the cervical adenitis was the antigen cannot be determined but is a logical conclusion. The allergic nature of the disease certainly war-

rants trial of the antihistaminics, a group of drugs that have relatively few side effects. This child never seemed very ill despite her high temperature. The skin lesions did not progress to the vesiculation and bullous formation which commonly occur. The eye and oral lesions did not progress after the third hospital day. The effect of the antihistaminics cannot be evaluated on the basis of this case, but their effect on this syndrome should be further investigated and their use continued until proved of no value or contra-indicated. The symptoms of cerebral intoxication in this child were attributed to the Benadryl or the fever. It is interesting to note that Howard and Pedvis (*20*), and also Fanconi (*27*), the only two authors reporting spinal fluid examination, report an elevated protein (43 mg. per 100 cc.) and a pleocytosis (lymphocytes 20 and 14, per cc. spinal fluid). The use of the antibiotics is essential in preventing secondary infection. We believe that penicillin is of proved value for this purpose.

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Bilateral Dermoid Cysts and Pregnancy

Report of a Case

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THE following case is presented because of the rarity of this condition and noticeable similarity to one recent reported by Berlind (*1*). He reported a case of bilateral dermoid cyst with a large fibroid of the fundus uteri and intrauterine gestation of 10 weeks. Similarly, a case of bilateral dermoid cysts in a 28-year-old prima gravida with a fundal fibroid and full-term pregnancy is herewith reported.

CASE REPORT

A routine roentgenogram of the abdomen of a 28-year-old primipara about 3 months before her expected date of delivery revealed an indefinitely outlined cystic mass apparently arising in the vicinity of the left ovary and extending well up into the left flank. In the lower portion of this mass there was a shadow that appeared to be a molar tooth. Above and a little lateral to this shadow there were other toothlike shadows. On the right a similar mass also containing a toothlike structure was seen. The outlines of a fetal skeleton were also seen (fig. 1). The patient had had no symptoms referable to these tumors and was unaware of their presence. She proceeded to full term at which time she spontaneously gave birth to a live 7½-pound infant. The puerperium was uneventful and 5 months later she was admitted for removal of the cysts. At this time palpation revealed a rather hard regular ovoid mass about the size of an orange in each lower abdominal quadrant. On pelvic examination a hard, tender, fixed, cystic mass about 7.5 cm. in diameter was palpated in the right adnexa. The left adnexal region contained a mass of about the same size, almost solid in consistency, freely movable and nontender.

Figure 1.—Roentgenogram showing bilateral ovarian cysts, each containing an opaque mass.

At operation a small fibroid measuring about 1 cm. in diameter was found on the anterior surface of the uterus. Each ovary measured about 6.3 cm. in diameter and was cystic with a very tough capsule. A tooth could be felt in

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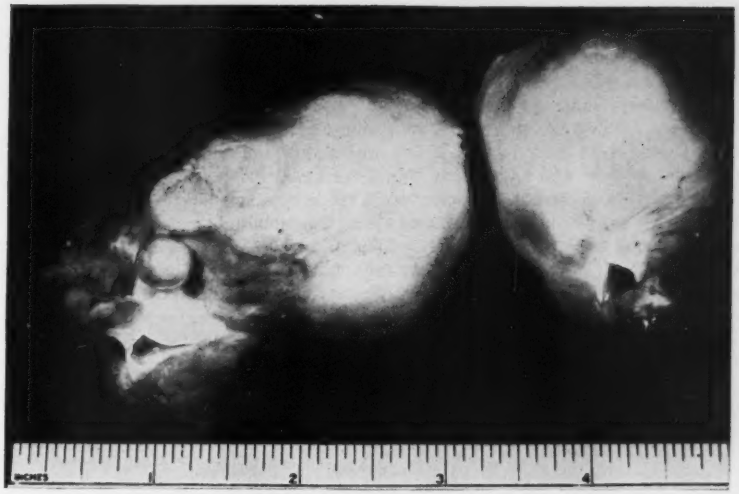

Figure 2.—Appearance of ovarian cysts before section.

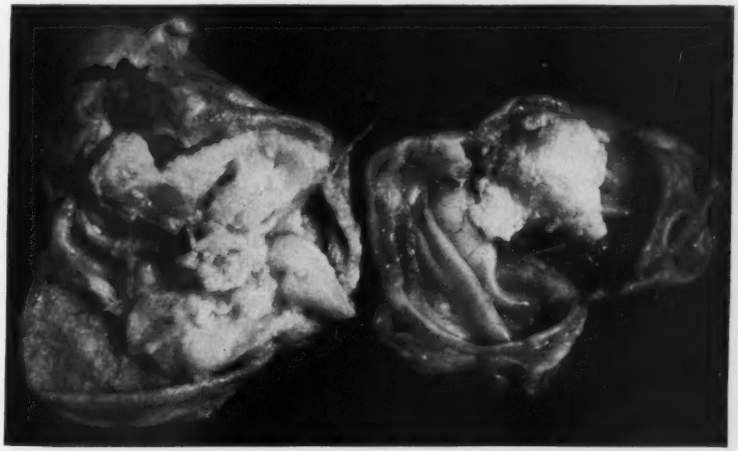

Figure 3.—Left ovarian cyst (on left) after section, arrow indicates toothlike structure. Right ovarian cyst after section shows hair and unbroken cyst containing clear fluid.

the wall of the left ovary near its vascular attachment. As this patient wanted to have more children, as much normal ovarian tissue consistent with safety was preserved. On the right side a small amount of ovarian tissue, about one-fifth the size of a normal ovary, was left behind. The cystic mass was shelled away from it without opening the cyst and without leaving any of its capsule. The left ovary was completely involved in the tumor and none of it could be

saved without danger of opening and spilling its contents. The uterine fibroid was also excised.

The cyst removed from the right ovary measured 7.5×5.0×4.5 cm. and that from the left was 4.5 cm. in diameter (fig. 2). The larger mass contained thick, grumous fatty material, a small amount of mucoid material, and some hair. About one-fifth of the wall was 2 mm. thick, and this portion of the wall contained some solid fatty tissue. There was a cyst 1 cm. in diameter containing clear serous fluid, and adjacent to this there was a firm, bony, or calcified area, 2 cm. long. Adjacent to the outer wall there was some recognizable ovarian tissue with a hydatidiform cyst attached. The smaller mass contained thick, green, opaque fluid, hair, and fatty material, and a calcified mass resembling a tooth (fig. 3). Microscopic sections from both specimens showed them to be similar. The walls were composed of fibrous connective tissue, which was fairly dense and contained, in some areas, small groups of lymphocytes and a few plasma cells. Outside this layer, there was a well-developed corium in which there were hair follicles and numerous large sebaceous glands. The lining was composed of thin, flattened, stratified squamous epithelium and atrophic rete pegs. The cyst contained numerous desquamated epithelial cells.

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Dupuytren's Contracture

Report of Two Cases

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DUPUYTREN'S contracture is a disease of the hands in which the gross deformity is thickening and contracture of the fibrous tissue of the palm of the hand. It is prevalent in men and in the aged; it has a strong hereditary tendency; trauma does not seem to play a part in the cause, for statistics show that this condition occurs more frequently in those who do not use their hands strenuously. Bunnell (*1*) states that in his experience he was impressed by the fact that persons with this condition show a tendency toward limitation of motion in their joints on slight provocation, apparently due to overgrowth, thickening, and contracture of ligamentous tissue. Reichel (*2*) brings out the interesting hypothesis of the existence of trophic nerves to the palmar fascia, and that as the result of injury to these nerve fibers Dupuytren's contracture results. He cites four cases in which the ulnar nerve was involved in injury or disease with subsequent development of the contracture. This is interesting in view of the fact that the disease is often most pronounced in that part of the hand supplied by the ulnar nerve.

PATHOLOGICAL FEATURES

Bunnell (*1*) describes the pathology as follows:

> Contracture of a part or all of the palmar fascia and its vertical attachments by proliferation of cicatricial tissue, drawing the proximal and middle joints of the fingers into flexion contracture, puckering in the skin of the palm—especially at the creases—to crescentic, funnel-like depressions and binding down the whole structure tightly to the sides of the metacarpals and the adjoining ligamentous tissue. The greatest proliferation is usually at the level of the distal crease in the palm, and is attached to the proximal margin and sides of the vaginal ligaments encircling the flexor tendons. The short fibers from the palmar fascia to the skin so proliferate and contract that they squeeze out all subcutaneous fat and even the sweat and sebaceous glands and the blood and lymph vessels, so that a thick plaque of tissue forms continuous between the epidermis and palmar fascia. Microscopic cross-section of the skin shows great thickening of the cornified layer, thinning and flattening of the stratum mucosum and obliteration of the papillae

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of the corium, which normally extend up deep in the epidermis. The papillae have been pulled downward and obliquely by the contracting fibers. Descending deeper we see nothing but dense cicatricial tissue which has squeezed out all the fat and deeper structures of the skin. Here and there may or may not be clumps of round cells, suggesting an inflammatory aspect. This tissue is somewhat more cellular and vascular in the early cases, but eventually becomes thick, dense cicatrix. All are fibroblastic. Some are packed with nuclei and in others there is largely intercellular matrix in longitudinal arrangement. From the irritation of repeated attempts to extend the fingers these contracting bands, which are like deep keloids, even microscopically, thicken and contract the more. In places, such as the distal crease in the palm, an area just proximal to the web of the thumb or the volar skin of the proximal segments of the fingers, the cicatrix under the skin may thicken to a solid, broad plaque, strangling out all fat and normal structures and covered by a mere thin layer of epidermis. When a digit remains in flexion contracture all of the tissues in its volar aspect—skin, nerves, joint capsules, etc.—become secondarily contracted, so that even after the palmar fascia and hands are excised the finger cannot be completely straightened.

Meyerding, et al. (*3*) stress the fact that

Dupuytren's contracture is not merely a disease of the palmar fascia, but involves all structures from the skin down to the tendon sheaths and that the process that involves the skin, subcutaneous tissue, and interstitial connective tissue is an inflammatory reaction marked by proliferation of capillaries and fibroblasts with marked perivascular lymphocytic infiltration. The palmar fascia is remarkable for the fact that within its fibers there is evidence of an active proliferation of fibroblasts without other signs of inflammation. The process progresses through the cycle of fibroblastic proliferation, and then deposition of collagen fibers which contract and compress the fibroblasts and the final picture of a vascular scar tissue result.

DIAGNOSIS

The essential features as quoted by Bunnell (*1*) are:

Dupuytren's contracture is so typical that there should be no difficulty in its diagnosis, unless it is present in combination with other conditions in the same hand. The characteristic features are loss of fat between the contracting bands and the epidermis, hard nodules and induration in the skin; transverse skin folds and crescentic puckerings, and the arrangement of the contracting cords corresponding with the natural bands of the palmar fascia. There is absence of tendon involvement; the digits can flex completely.

Shortened tendons result in flexion of the distal joints which are, if anything, extended in Dupuytren's contracture. Motions of the digits in tendon shortening will be found to be affected by the position of the wrist joint.

In spastic conditions, unlike Dupuytren's contracture, the proximal joints are usually in extension and the distal two joints in flexion. The other hand, in Dupuytren's contracture, is also usually involved.

CASE REPORTS

Case 1.—A 46-year-old man was admitted complaining of contracture of the fingers of both hands. In 1934 he first noticed a small lump under the skin of the palm of the right hand. This did not disturb him in any way. As time passed the fourth and fifth fingers of the right hand and the fourth finger of

the left hand began to be drawn toward the palms and he was unable to extend them fully. As the fingers were curling, tight cords formed in the palms of his hands. At present he seeks relief because the curled fingers interfere with his handling of tools, and on occasions he is unable to release what he holds in his hands. There has never been any pain or inflammation.

He served in the Navy for 20 years during which time he handled small boats a great deal, and since his retirement he has performed manual labor as a machinist.

His only other complaint is morning cough with profuse mucopurulent sputum.

Past history.—As a boy he had a severe infection of the left index finger which required surgical drainage. He has not been able to completely extend the finger since then. He had syphilis in 1922 for which he received 2 years of treatment. In 1934 he had gonorrhea complicated by epididymitis.

The family history was irrelevant.

Physical examination.—The patient was a well-nourished and well-developed 46-year-old white man in apparent good health. The fourth and fifth fingers

Figure 1.—Limit of extension of the fingers.

of the right hand are held in the position of 50 percent flexion. He is able to fully extend the middle and distal phalanges but extension of the proximal phalanx is limited to 50 percent extension. There is no limitation of flexion. The skin of the palm in the medial half is thin and there are deep pits at the distal palmar crease between the metacarpals and thick, firm, very tense bands of palmar fascia over the third, fourth, and fifth metacarpals. When extension of the proximal phalanges is attempted these bands become more tense. There is nodular thickening of these bands about the distal palmar crease. There is no thickening of the palmar fascial over the first metacarpal, and very little of the second. There is no inflammation, no tenderness, on change or loss of sensitivity. The dorsum of the hand is normal. Circulation is unimpaired.

The left hand presents essentially the same findings in a lesser degree (fig. 1); the index finger has an old scar 4 cm. long along the flexor surface which

limits complete extension. Pertinent laboratory examinations were within normal limits. The sedimentation rate was 13 mm./hr.

Operation.—On 29 July 1948 resection of the palmar fascia of the left hand was done under intravenous sodium pentothal anesthesia. A tourniquet was applied to the arm throughout the operation. An incision was made beginning over the pisiform bone and coursing distally over the midpart of the hypothenar eminence to a point just distal to the distal palmar crease, then coursing laterally over the heads of the metacarpals to the base of the index finger. Only the skin was incised. Small skin hooks were applied to the skin to retract the edge; then by the use of a small-bladed scalpel and iris scissors the fibrous bands and thick scar between the palmar fascia and the skin were cut. Where the palmar fascia was most thickened, and especially at the distal crease where the skin was pitted, the skin had to be shaved of longitudinal strands of fascia. The skin flap was dissected and elevated to the extent that the base of the triangular flap was on a line from the pisiform bone to the distal head of the second metacarpal. By the same method the skin from over the head of the metacarpals to the web of the fingers was dissected free and elevated. There was relatively little fat between the most involved part of the fascia and the skin.

The base of the fascia at the heel of the hand was separated from the underlying tendons, nerves, and vessels and severed from its attachment to the palmaris longus tendon. The fascia was then grasped with a Kocher forcep and elevated to make the deep attachments of the fascia to the interosseous fascia taut. These arching attachments were dissected out and severed until the fascia was held only by the bands running down the fingers. These bands were severed at a point as far distally as allowed by the incision. As each volar digital nerve and artery was reached the fascial septum running between them and the flexor tendons was trimmed off deep in the hand where it joins the ligaments at the side of the metacarpals and the transverse and vaginal ligaments. The palmar fascia was greatly thickened especially over the third and fourth metacarpals. As the fascia was resected the fingers could be freely and completely extended. The thickened fascia over the hypothenar and medial part of the thenar eminences was also trimmed off. The tourniquet was then released. Several small bleeders were grasped and ligated. There was one small buttonhole of the skin at the distal crease opposite the fourth finger and the skin was shaved very thin in this area. However, it was considered that this skin had good chance of viability. The skin edges were then sutured in place with multiple interrupted sutures of dermal. The buttonhole served as a drainage point.

A voluminous fluffed-gauze pressure dressing was applied and the hand splinted with the fingers in slight flexion.

Pathologist's report—Gross: The specimen consists of a formalin-fixed mass of heavy strands of fibrous tissue. It is extremely firm. *Microscopic:* Sections show dense fibrous tissue which is irregular in pattern. There are a considerable number of chronic inflammatory cells. The architecture is distorted by rather intensive fibroblastic and fibrocytic proliferation into and around the fibrous bundles. There is considerable edema and hyperplasia of the walls of the blood vessels. Several sweat glands are seen.

Postoperative course and treatment.—No antibiotics were given and his temperature remained normal. The first dressing was on the tenth postoperative day at which time the skin flap at the distal medial part appeared devitalized because of poor circulation. Half the sutures were removed and another pressure dressing was applied as well as a splint. At the next dressing, the twentieth postoperative day, good progress with evidence of reestablishment of circula-

tion in the skin flap was noted. The remaining sutures were removed. Daily whirlpool baths, massage, and exercises for the fingers were begun. The hand healed slowly but without interruption. The skin about the distal palmar crease was very thin and fragile. The fingers were rather stiff, especially the fifth finger, but by physiotherapy and occupational therapy the function of the left hand was good enough by 15 September so that the patient could feed and shave himself.

On 30 September 1948 the right hand was operated on. The surgical procedure was essentially the same except that the vertical limb of the incision was placed one centimeter more ulnarward than that on the left hand; also, as the pathological process was somewhat more extensive with considerable thickening of the extensions of the fascia into the fourth finger, a midlateral incision was made over the proximal phalanx and, after location and protection of the digital nerves and vessels, all the thickened fascia was dissected out of this area. As in the left hand the skin flap was shaved very thin in the region of the distal palmar crease, and there were two small buttonholes of the skin. It was again decided that this flap was at least as good and probably better than a split graft so it was sutured in place. A voluminous pressure dressing was applied and the hand splinted with the fingers in slight flexion.

Postoperative course and treatment.—Only anodynes were prescribed. The hand was not dressed until the tenth postoperative day. The skin flap looked good although there was about 5 cc. of old liquid blood beneath it, which was expressed. The sutures were removed, and the same type dressing and splint applied. Because of the danger of infection of the hematoma, he was given penicillin, 25,000 units every 3 hours. On the thirteenth postoperative day he complained of burning in the palm of the hand. The palm was inspected and it was found that an area of skin about the size of a quarter was elevated at the angle of the incision by a hematoma and was necrotic; the tissue was excised and the hand redressed. The next dressing was done on the twenty-first postoperative day; in the meantime the patient had slight discomfort. At the time of this dressing there was slightly more skin necrosis and a slight inflammatory reaction of the whole distal palm. His temperature had remained normal. The penicillin dose was increased to 50,000 units, however, and warm saline dressings were given twice daily, and whirlpool baths once daily. Under this regime the ulcer gradually became clean and the borders of the ulcer began to epithelialize. On the thirty-eighth postoperative day penicillin was discontinued. By this time the ulcer was almost completely healed, but the midpalm was thickened by organized hematoma and the fingers were very stiff. Physiotherapy was continued daily and occupational therapy begun. On 18 November 1948, the fifty-first postoperative day, the palm was well healed with a complete but thin scar. There was still some stiffness of the fingers but this was much improved. The left hand had almost normal function with only slight stiffness of the fifth finger. He was discharged to his home where he was to continue physiotherapy.

The pathologist's report on the fascia of the right hand was the same as that of the left.

On 14 January 1949, 6½ months after surgery of the left hand, and 3½ months after surgery of the right hand, the patient was seen for a postoperative evaluation. At this time both palms were completely healed but the skin was rather thin and pink. Blanching by pressure was quickly replaced by return of blood. He had full extension and flexion of all the fingers, and they were limber (fig. 2). His grip was strong. He was planning to return to his work as a machinist in the next few days.

Figure 2.—Appearance of hands 6½ months after surgery on the left hand and 3½ months after surgery on the right hand.

Case 2.—This 33-year-old white man was admitted complaining of a nodule in the palm of the right hand of 1 year's duration. After using the hand very much, for example, driving his automobile for a long period, there was some pain and fatigue of the hand. When the fingers were hyperextended there was a pulling sensation in the palm. In the past year this nodule has slowly increased in size. There were no other complaints.

Past history.—He had had only the common childhood diseases.

The family history was noncontributory.

Social history.—His work had always been of a clerical nature, and he had not used his hands in such manner to traumatize them excessively.

Physical examination.—The patient was a 33-year-old white man in apparent good health. The only significant finding was in the right hand. In the palm of the hand, over the distal head of the fourth metacarpal, is a firm, smooth indefinitely outlined oval tumor mass 1 cm. long and 7 mm. wide and slightly raised above the palmar fascia. Its center is just distal to the distal palmar crease, and at this crease the skin is rather deeply pitted. There is only slight limitation of full extension of the fourth finger, and when this finger is extended as fully as possible a firm wide band in the palmar fascia overlying the fourth metacarpal is outlined. There is no tenderness or apparent inflammation. The middle and distal interphalangeal joints of this finger have full range of motion. The other fingers of the hand also have full range of motion. Except for the pitting over the tumor, the skin of the palm appears normal in texture. The left hand appears normal in all respects.

Laboratory examinations which included roentgenogram of the chest, bleeding time, clotting time, urinalysis, red and white blood cell count, and blood Kahn test were all within normal limits.

Diagnosis.—Early Dupuytren's contracture.

Indications for surgery.—It was decided to resect the palmar fascia at this early phase of the disease because it is known for its chronicity and progressiveness, with further deformity and resultant loss of function of the hand. It was also believed that resection of the fascia while it was only moderately involved would be a less difficult procedure than at a later date.

Operation was performed on 6 August 1948. The details of the operation in regard to the incision and the procedure of the resection of the fascia were essentially the same as that reported in the preceding case. However, the lines of cleavage between the fascia and its neighboring structures were difficult to work out and the dissection was tedious and annoying in that the fascia frayed and tore easily when traction was applied to it. The palmar fascia from its attachment to the palmaris longus to its extensions into the third, fourth, and fifth fingers was resected. The skin flap was not perforated and was sutured in place with good anatomical approximation. A pressure dressing was applied and the wrist and hand splinted with the fingers in slight flexion.

Postoperative course.—On the seventh postoperative day the hand was dressed and the sutures removed. At this time the skin flap looked good except for a narrow zone of devitalization at the distal margin of the skin flap. A pressure dressing and a splint were applied.

Pathologist's report.—Gross: Specimen consists of a formalin-fixed mass which measures 4 cm. in length. It is stringlike at one end and is 0.5 cm. wide at the other end. Cut section reveals rather firm tissue. Microscopic examination reveals a mass of acellular connective tissue with foci of round cell infiltrations and intertwined nerve fibers. No epidermis was present.

Anatomic diagnosis.—Hyperplasia of palmar fascia.

On the ninth postoperative day the patient complained of a burning pain in the palm of the hand. Examination of the part revealed that a large hematoma had formed under the skin flap. This hematoma was partially organized.

Figure 3.—Appearance of hand on 15 December 1948, 4 months after surgery.

Further treatment consisted of the administration of penicillin, 50,000 units every 3 hours, and daily dressings with the expression of some clot from the hematoma each time.

No gross infection occurred. The distal third of the skin flap became devitalized and was excised as it became detached. By the thirtieth postoperative day most of the hematoma was extruded or absorbed and the defect of the palm began to slowly heal. From the twenty-first postoperative day he received daily whirlpool baths and exercises for the fingers.

By the fortieth postoperative day there remained an ulceration the size of a quarter, slight localized swelling of the palm due to organized unabsorbed clot, and some stiffness of the fourth and fifth fingers. At this time he was discharged with instruction for taking physiotherapy at home.

On 15 December 1948 he was seen again at which time there was still some thick scarring of the palm, the skin was healed with a wide scar at the point of skin devitalization (fig. 3), but he had full range of motion of all the fingers and he was asymptomatic.

COMMENT

In two of the three hands in this series the postoperative course was complicated by hemorrhage in the palm following the removal of the skin sutures, in one case on the seventh postoperative day and on the tenth postoperative day in the other. This resulted in devitalization of part of the skin flap in each case, but with eventual satisfactory healing. It may be well not to remove the sutures until about the fifteenth postoperative day. Because of the predilection for fibrosis and shortening of joint capsules in these patients physiotherapy was instituted by the third postoperative week notwithstanding the previously mentioned complication.

In the hands where there was thinning and pitting of the palmar skin, this skin was shaved very thin and buttonholed in removing all the fibrous tissue. In the future it may be wise to employ the method recommended by Skinner (*4*) in grafting this part of the skin defect. After resection of the palmar fascia and suturing of the skin flap, Skinner places one or two "tunnel grafts," which are narrow split thickness grafts placed transversely under the thinned-out palmar skin, usually at the palmar creases. The original, devitalized skin overlying these grafts sloughs or is excised in about 2 weeks.

Some surgeons (*5*) advise, in instances such as case 2 where the disease is grossly limited to one segment of the fascia, resection of only that grossly diseased part with its overlying skin, and filling in the defect with a split thickness graft.

Resection of three palmar fascias is too limited an experience from which to draw conclusions, but we were impressed with the relatively greater difficulty in resecting the fascia of the second patient whose fascia was only moderately involved and who had little disturbance of function of the hand. Although the first patient had extensive

involvement of the fascia and loss of function of the hands, the greatly hypertrophied tissues were technically easier to remove. It may be well to wait until the disease has progressed to an incapacitating degree, but before permanent shortening of the other tissues of the hand has occurred, before advising surgery.

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The Long-Cuff Endotracheal Tube

Its Manufacture and Use

RALPH T. KNIGHT[1]
ARTHUR B. TARROW, *Major, U. S. A. F. (MC)*

THE long-cuff endotracheal tube has been used at the University of Minnesota since 1942 (*1*). It was developed to solve the problems of vocal cord and tracheal irritation which follow lengthy use of the endotracheal tube. It proved so useful that it was adopted for all operations in which a complete tracheal air seal and bronchial cleanliness was deemed essential.

During the month of July 1949, 218 surgical procedures lasting from 15 minutes to 10 hours and 25 minutes (averaging 2 hours and 50 minutes per case) were carried out at the University of Minnesota Hospital; in this series, 138 patients were intubated.

There were several reasons for this large number of intubations. Besides the surgical operations in the chest and abdomen, which obviously required the use of endotracheal tubes, it was believed wise to intubate patients scheduled for such surgical operations as radical mastectomy and cholecystectomy. These patients might have been anesthetized and surgery done without an endotracheal tube but endotracheal intubation was done to insure adequate respiratory exchange and to permit access for free removal of tracheal and bronchial secretions during the long operating periods. The use of a combination of intravenous pentothal-curare and inhalation nitrous oxide-oxygen (in 83 cases) made it advisable to augment the respirations in order to obtain perfect oxygenation.

The long-cuff endotracheal tube is best inserted by the oral route because it is somewhat bulky for passage through the nose. However, when advisable it can be so inserted (*2*). The correct size endotracheal tube for each patient is determined before intubation by placing endotracheal tubes of varying lengths alongside the patient's neck in the

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natural curve. The tube which reaches to the suprasternal notch, approximately 4 or 5 cm. from the coryna is used. When inflated to 16 cm. water pressure, the cuff adapts itself to the trachea, vocal cords, and hypopharynx, resulting in a soft, cushion seal of the vocal cords from above and below (fig. 1).

The cuff, manufactured from commercial condoms, is deflated every 15 to 30 minutes to prevent any possibility of vocal cord compression. However, 16 cm. water pressure causes little tension. When no manometer is available the cuff may be inflated by blowing into the inflating catheter until air will not leak around it when the breathing bag is compressed manually.

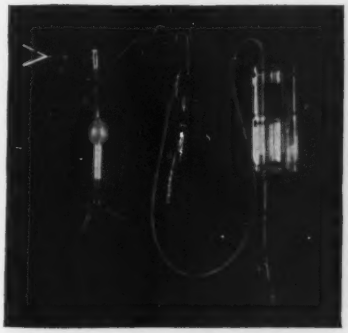

Figure 1.—The long-cuff endotracheal tube in place. (a) *Adam's connector to anesthesia machine;* (b) *endotracheal tube, 23 cm. long;* (c) *model of trachea and main bronchi (18 mm. in diameter). The endotracheal tube extends to within 4 cm. of the coryna;* (d) *tubing from* (e) *water manometer to inflating catheter.*

After each use the endotracheal tube is washed inside and out with soap and water. It is then soaked in a germicidal solution such as aqueous Zephiran chloride for 1 hour.

There are several disadvantages to the use of this type of cuff. Endoctracheal intubation may be more difficult because of obstruction to vision by the bulky cuff in the restricted area of the hypopharynx. Another difficulty is that the cuffs are relatively fragile and must be replaced periodically. Some cuffs may last for only four or five uses and others many times this number depending on the manner in which the intubation is handled, the method of washing and soaking, the type of solutions used, and the care with which they are stored between uses. Waters (*3*), experimenting with long cuffs, found that the tube had a tendency to be drawn from the trachea when the pharyngeal portion was inflated.

These disadvantages are relative. The anesthesiologist quickly becomes accustomed to intubating with the more bulky tube. The cuffs can be replaced so easily and for such little cost, that loss of a cuff causes no difficulty. Sanders (*4*) is manufacturing an excellent long cuff of durable material, modeled after that of Grimm and Knight (*1*). However, for those who wish to manufacture large numbers of cuffs for endotracheal tubes of various sizes and shapes, the condom is readily available. When the cuff is long enough, it has been found that the tube will not be drawn out of the trachea. The various

shapes, sizes, and materials available commercially are illustrated in figure 2. They are:

(*a*) Commercial rubber endotracheotomy tube. This is made with a Magill angle and placed within the trachea after removal of the entire tracheotomy apparatus. The outside diameter corresponds to Lundy No. 6, Magill No. 9, and French No. 33.

(*b*) Commercial rubber tube, 16 cm. in length, for use in children 6 to 10 years of age. The outside diameter of this tube corresponds to Lundy No. 4, Magill No. 4, and French No. 26.

(*c*) Commercial rubber tube, 21 cm. in length, for use in small women or large children. The outside diameter corresponds to Lundy No. 5, Magill No. 6, and French No. 28.

(*d*) Portex tube, 23 cm. in length, for use in the average adult man or woman. The outside diameter corresponds to Lundy No. 6, Magill No. 9, and French No. 33.

(*e*) Forreger rubber tube, 23 cm. in length, with same dimensions as (*d*).

(*f*) King-Magill rubber tube No. 9, 23 cm. in length, with universal adaptor connectors. The dimensions are the same as (*d*).

(*g*) King-Magill rubber tube No. 10, 30 cm. in length, with a short cuff and universal adaptor connectors. The outside diameter corresponds to Lundy No. 6 and 7 and French No. 37. This tube is useful in intubating animals.

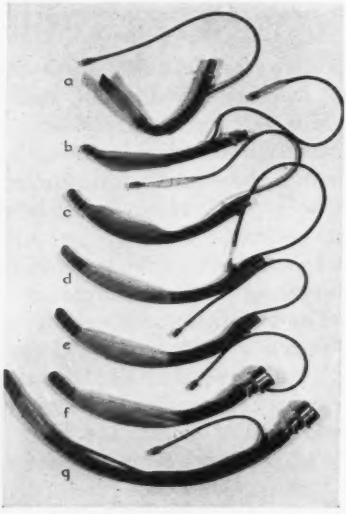

Figure 2.—Variations in shapes, sizes, and materials of the long-cuff endotracheal tube.

We found that an important advantage in the use of this type of cuff was the relative absence of pathologic vocal cord changes despite lengthy use. In addition, not a single case of tracheal ring or tracheal mucosa irritation has been reported since the change from the usual small commercial cuff (*1*) (*4*). Another advantage is that the long cuff seals the vocal cords from above. This insures a clear trachea in case of regurgitation of gastric contents. At the end of any procedure the pharynx is always cleansed as completely as possible, and careful tracheal toilet carried out to remove any other secretions and to assure an airway free from foreign material postoperatively.

THE MANUFACTURE OF THE TUBE

The following equipment is needed to manufacture long-cuff endotracheal tubes: (*a*) condoms; (*b*) rubber tubing. "Davol" rubber laboratory tubing has been found to be the best obtainable for this purpose. Size $\frac{3}{16} \times \frac{1}{16}$ (No. 2610) is used for making Lundy No. 4 tubes; size $\frac{1}{4} \times \frac{1}{16}$ (No. 2615) is used for making Lundy No. 5 tubes; size $\frac{5}{16} \times \frac{1}{16}$ (No. 2619) is used for making Lundy No. 6 tubes; (*c*) French No. 8 catheters; (*d*) small Penrose drains; (*e*) rubber cement; (*f*) "Miracle cement" (obtainable in any hardware store); (*g*) scissors; (*h*) sandpaper; and (*i*) talcum powder.

As noted in figure 3, the steps in the manufacture of the long-cuff endotracheal tube are as follows:

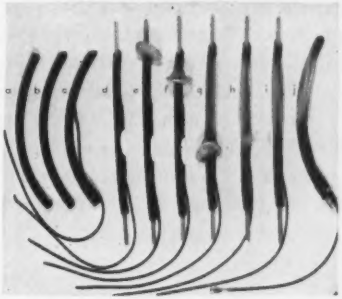

Figure 3.—Steps in the manufacture of the long-cuff endotracheal tube.

(*a*) A tube of the desired length is cut from stock tubing. For Lundy No. 6 or Magill No. 9 size, the length usually should be 23 cm. However, lengths of 21 to 22 cm. are also cut to insure an individualized fit for various-sized patients. Length for Lundy No. 5 or Magill No. 6 varies from 19 to 21 cm. Length for Lundy No. 4 or Magill No. 4 is usually 15 to 16 cm. Tubes of various sizes and shapes may be cut at one time because it is just as easy to manufacture several at once as to do each separately.

Any type of tubing material may be used. The cuff may be applied directly to commercial tubing, Forreger rubber tubing, or Magill tubes. However, in order to apply cuffs to Portex tubes, a tight 1 cm. circlet of Penrose drain must first be applied to the tube at the beveled end because rubber cement will not stick to this plastic material. The procedure is the same thereafter.

(*b*) One end of the tube is beveled to an angle of 45°. All tubes used at the University of Minnesota are beveled to the left; i. e., the beveled edge faces the laryngoscope when intubating. It is believed that this allows for greater visualization and facility. This bevel may be smoothed by sandpapering. Another method of smoothing the bevel is to hold it over a flame until the rubber begins to burn. Quickly wiping this charred surface with a cloth dampened with noninflammable chloroform will leave the surface smooth. The addition of a little talcum powder overcomes any sticky residual effects. One can smooth a dozen tubes in five minutes with the chloroform method.

(*c*) A cut of 1 cm. is made in the flared end of a French No. 8 catheter. This flare is then flattened and attached to the concave curvature

of the tube about one-third of the way from the beveled end by means of a circlet of Penrose drain and rubber cement. Another circlet of Penrose drain is rolled over the unbeveled end to hold the catheter out of the way during manufacture and use.

(*d*) Long, wooden applicators such as are used in sigmoidoscopic examination are forced into the lumen of the tube until it remains straight and rigid. This assists in the application of a tight cuff. "Miracle cement" is placed around the catheter about two-thirds of the way from the beveled end (in figure 3, represented in white for contrast). It is allowed to dry for 20 minutes, after which it may be shaped around and over the catheter. The purpose of this puttylike cement is to fill and seal the crease between the tube and catheter. It also serves to bulwark the thinwalled French No. 8 catheter so that it will not be compressed when this end of the cuff is sealed around it with tight binding. The tube is put aside for 24 hours to allow the cement to harden completely. (The portion of the tube with the hardened cement never enters the vocal cords but remains in the hypopharynx.) When this cement has hardened, the anesthesiologist has the basic tube. Torn condoms may be replaced, using this basic tube over and over again.

THE CUFF

(*e*) A hole, 1 to 2 mm., is punched in the end of a rolled condom. A drop of water-soluble jelly is applied to the bevel. By pinching the bevel and stretching the condom, the tube can be squeezed through this narrow hole. It is pulled 3 cm. from the beveled end, and then rolled back toward this end so that the surface of the tube may be moistened by rubber cement for a distance of ½ cm.

(*f*) The condom is then rolled back over this sticky surface and molded until a tight seal results.

(*g*) Rubber cement is ringed around the tube at the level of the "Miracle cement." The condom is stretched tightly in pleats and fastened here. The excess condom is cut off.

(*h*) A tight binding of strips of condom is wound and cemented in layers at this point. Talcum powder is dusted over this area to eliminate stickiness.

(*i*) A circlet of Penrose drain is slipped over the unbeveled end of the tube and cemented to this area to doubly insure a tight seal and to prevent the strips of condom from unwinding when soaking the tubes after use.

(*j*) Connectors are attached at the unbeveled end. (Adams connectors are shown (fig. 3).) The point of a 15 gauge needle is filed off and the needle inserted into the free end of the French No. 8 catheter.

As seen in figure 1, the cuff may be inflated by water manometer, which is also easy to manufacture. The essential feature of any such manometer is that the cuff is inflated by the pressure of the weight of 16 cm. of water (figs. 4 and 5).

Figure 4.—Water manometers.

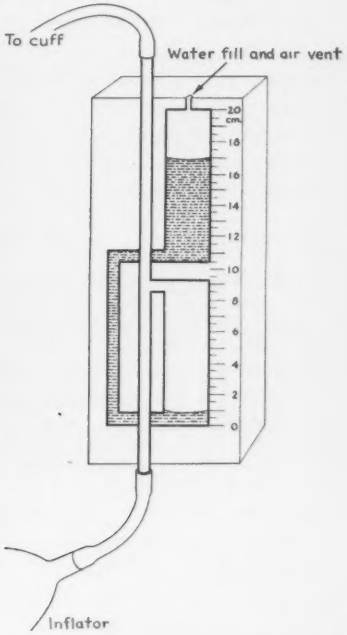

Figure 5.—Cut-away representation of the lucite manometer.

(*a*) A type of manometer with inside copper tubing (fig. 4). This simple form of manometer was suggested by S. Ross Melgaard, formerly of the anesthesiology staff at the University of Minnesota. Such manometers are relatively fragile because the water containers are made of glass. By encasing the glass in a wood frame or by strips of rubber, this hazard may be reduced. The manometer shown here is still in use after several years of careful handling.

(*b*) The latest type of manometer (fig. 5), made by drilling into a block of lucite, a plastic material.

Note that in figure 1, the water is in the upper chamber when the cuff is inflated. In figure 4, with the manometer not in use, the water drops into the lower chamber.

The use of water manometers was suggested by Dr. Clarence Dennis, Professor of Surgery at the University of Minnesota, following a case of severe tracheal irritation which followed the employment of a

short commercial cuff. The cuff used in this case was overinflated by blowing into the inflating catheter.

SUMMARY

The long-cuff endotracheal tube has been used during anesthesia in 138 patients. It has been shown to have an important advantage over other tubes in that it will not produce pathologic vocal cord changes or evidences of tracheal mucosa irritation despite long use. It seals the vocal cord from above and insures a clear trachea in case of regurgitation of gastric contents and thus permits in obtaining an airway free from foreign material postoperatively. The steps in its manufacture are described.

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Experiences With the Marrow Nail Operation According to the Principles of Kuentscher[1]

Gunshot Fractures of the Femur

PART V[2]

PROF. DR. C. HAEBLER

THE mortality rate in gunshot fractures of the femur was high (10 percent); there were five fatal cases, three of which were treated outside our clinic. One death was caused by improper treatment of the wound infection, another was caused by fat embolism, and a third and fourth from operative shock.

One patient who died from operative shock had a 4-month-old fistulous gunshot fracture. A roentgenogram revealed several sequestra. On the third day, after the adminstration of 3 cc. of evipal, circulatory and respiratory collapse occurred and surgery was postponed. Fourteen days later it was necessary to stop a blood transfusion because of nausea and labored breathing. After that all treatment was jeopardized by the occurrence of severe vasomotor instability. Treatment of the general circulation for 3 weeks prior to the operation permitted the patient to withstand the removal of six large sequestra without special difficulty, but when the connective tissue scars of the fragments were mobilized his pulse rate rose to 140. In spite of this, nailing was performed. Circulatory collapse occurred and he did not respond to infusions and heart stimulants which were administered during the operation. The patient died 9 hours after the operation. Post mortem revealed fatty degeneration of myocardium and liver and anemia, but no fat embolism.

There is no doubt that the nailing caused the death in this case. The nailing of a femur fracture is a major operation, no matter how smooth its performance may be. This fact must be borne in mind especially in fractures due to gunshot injuries.

[1] Translation prepared by the U. S. Naval Technical Unit, Europe (Medical Section), Office of Naval Advisor, Office of Military Government (U. S.), edited by U. S. NAVAL MEDICAL BULLETIN.

[2] Parts I to IV were printed in the U. S. Naval Medical Bulletin beginning with the May–June 1949 issue.

A fifth case had no connection with the marrow nailing operation. This patient had a year-old chronically infected compound fracture of the femur in which a 3-cm. long tubular sequestrum had developed. The knee and hip joints had stiffened considerably. Repeated attacks of renal colic and large numbers of leukocytes in the urine indicated the formation of calculi in the left kidney, but no stones could be found.

Because of atrophy of the bone, the nailing was performed only as a last attempt to save the limb. The patient, an active officer, insisted on having the operation performed. The osteosynthesis was stabile in the beginning, but the nail loosened very soon so that rotary movements of the distal fragment became possible. A large decubitus ulcer over the sacrum and an empyema of the knee joint were observed 4 weeks after the operation; the decubitus ulcer did not heal regardless of treatment. The general condition of the patient became worse, so the limb was amputated at the thigh 8 weeks after nailing. The patient recovered at first, but later we observed abscesses, septic hemorrhages, and an infection of the hip joint. After a resection of the hip joint the general condition of the patient improved and the decubitus ulcer healed, but 8 months after the nailing a nephrectomy was performed because of a pyonephrolithiasis. Four weeks later erysipelas spread from the stump of the thigh and the patient died.

Although the marrow nailing was not directly the cause of death, it is probable that the infection of the knee and hip joints would probably have been avoided if the nailing operation had not been performed; there is no doubt that the irritation which was caused by the nailing was responsible for the subsequent infection of the stiffened joints.

It must, therefore, be concluded that the nailing operation of an infected fracture should not be performed if the joints have stiffened. Mobilization of the joints in the course of the operation cannot be avoided, and this only increases the danger of infection.

A survey of the cases of nailed gunshot fractures of the femur that were observed by the author until the removal of the nail is given in table 9. In the first column is included fractures, the wounds of which had been healed for over 9 months and which also would have been suitable for other methods of osteosynthesis.

All fractures came to a bony union, and this is certainly a good result. That fistulae formation and sequestra will take place in infected fractures is a matter of course and will occur in much the same way in conservative methods. However, an infection of the marrow cavity can definitely be avoided by using the conservative methods. If the nail constitutes a hazard it should not be used.

TABLE 9.—*Marrow nailing in old gunshot fractures*

	Number of cases	Bony union	Accompanied by	
			Formation of sequestrae	Osteomyelitis
Osteotomies, wounds healed for more than 9 months	8	8	3	1
Osteotomies, healed for 2 or 3 months	5	5	[1] 2	1
Osteotomies healed for 6 weeks	4	4	[2] 1	
Pseudarthroses 8 to 18 months old, with wounds healed 6 to 7 months	4	4	2	2
Pseudarthroses 8 to 18 months old, with wounds healed for 3 to 5 months	3	3	[2] 1	
Old fractures 6 to 14 weeks old, wounds healed for 6 weeks				
Old fractures, 1½ to 12 months fistulating	19	19	10	[3] 1
Old fractures, 4 to 12 weeks purulent	7	7	7	
Total of fractures, the wounds of which were healed after less than 6 months or were still purulent	45	45	[4] 22	[1] 3

[1] Formation of sequestrae of 1 case after removal of nail.
[2] Formation of sequestrae after removal of nail.
[3] Perforation of the point of nail, para-articular abscess after removal of nail.
[4] Formation of sequestrae of 3 cases after removal of nail.

Figure 84*a* is a roentgenogram of a 4-month-old femur fracture that united in faulty position; the wounds had healed after 2 months. The osteosynthesis was stabile. The wounds had been primarily sutured without drainage and when infection developed the surgeon waited 5 days before opening the wounds widely, consequently the purulent secretions followed the path of the nail which acted as a drain and finally infected the marrow cavity. Figure 84*b* is a roentgenogram made 4 months after nailing; osteomyelitis had developed in the fracture cleft and in the proximal fragment.

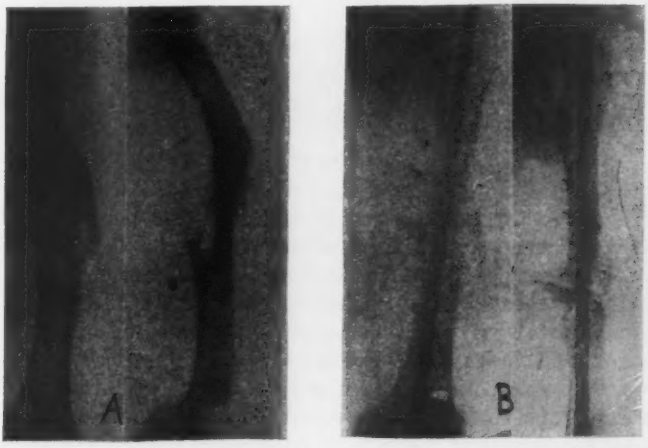

Figure 84.

In an 8-month-old pseudarthrosis in the distal third of the femur (the wounds had been healed for more than 5 months) a primary suture was applied. The osteosynthesis was only relatively stabile in this case. The nail found a grip in the spongiosa of the distal fragment (fig. 85*a*) and the patient was allowed to use the limb 9 days after the operation. A week later, a collection of pus in the adjacent tissues was drained. Eight days later the wound secretion became purulent and fever set in. When the wound was finally inspected (29 days after the operation) the roentgenogram (fig. 85*b*) showed osteomyelitis and periosteal deposits. An abscess developed in the wound at the trochanter and a gravity abscess and an osteomyelitis, which spread as far as the subtrochanteric areas, developed, which necessitated (even after the removal of the nail 3½ months later) several sequestrotomies. The final result after treatment for more than 2 years was a stiff knee joint.

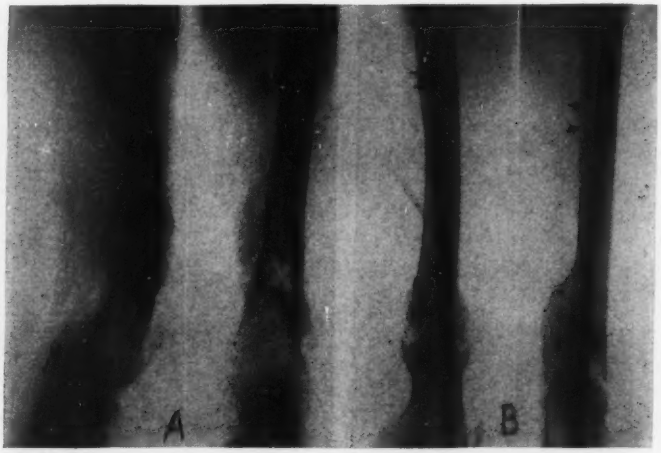

Figure 85.

The nailing operation cannot be blamed for the poor results in the previously mentioned case; unsuitable treatment and improper technique were responsible. The fixation of the fracture would have been possible by conservative treatment. The report of the operation states: "with a view to reducing the fragments and of driving the marrow nail in the distal direction, it became necessary to separate the fracture cleft widely, which was not easy to perform. Although the fracture is not solid we observed considerable masses of callus at the posterior part of the cleft." Impatience of the surgeon (and of

the patient) influenced the indication in this case. This impatience is confirmed by other facts; osteotomy, because of faulty position, was justified and correctly performed, then a plaster cast was applied, additional fruit diet, vitamin C, and diathermy were given "because the callus formation was only slight after 5 weeks." The plaster cast was removed after 8 weeks and a Volkmann's splint applied. Diathermy was then used and the patient was given calcium, C-Bion, and massage because "more properly, although the fracture was still movable." As could be expected the fracture came to a posterior angulation of the distal fragment. The limb was left on the Volkmann splint and the fracture was immobilized with a sand bag (a measure which is never of any use). Three months after the osteotomy, Beck's drilling was performed and the limb put in a walking cast 4 weeks later. When the roentgenogram did not reveal enough callus 4 weeks later it was "considered whether a marrow nail might bring the necessary fixation and stimulate the formation of callus. The nail could, at the same time compensate the antecurvation." If the walking cast had been applied after osteotomy or the antecurvation had been corrected under anesthesia and the walking cast left in position long enough, the fracture would have united quicker and with better results.

The delayed opening of the wound was responsible for the spread of the infection into the marrow cavity. This is confirmed by the localization of the osteomyelitis which developed in the proximal fragment where the least mechanical counterpressure is (in the path of the nail toward the soft parts) above the trochanter. It did not spread into the distal fragment because the spongiosa and bone mantle offered no outlet.

The reaction is different if the nail does not have a firm hold in the bone. The nail will then permit tilting movements when the limb is used and will force or suck the infected secretions into the empty spaces. This was observed in an osteotomy nailing of an 11-month-old gunshot fracture, the wounds of which had healed 10 months prior to the operation. A drain was inserted and the limb put in a plaster cast. A decubitus ulcer formed on the heel; this was incised and 2 weeks later the fracture became infected.

This reaction was also observed in the osteomyelitis of an 8-month-old fracture of the femur in which the nail did not obtain a firm hold. The patient, whose wounds had been healed for 6 months, was admitted because of a faulty position, "absence of callus, and imminent pseudarthrosis." It was decided to nail this fracture by the open method, although clinically the fracture had solidified to a considerable extent. The necessity of removing most of the transversely located bone splinters which would cause considerable shortening was

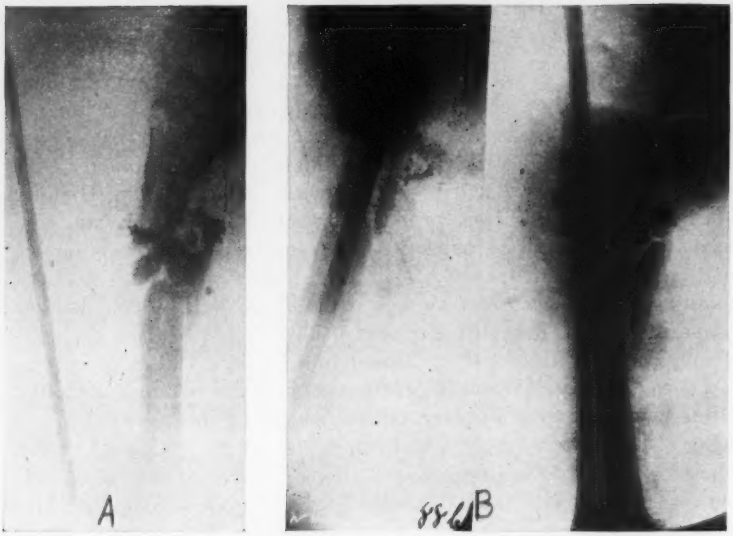

Figure 86 a and b.

overlooked, and on roentgenogram checking of the medium-size nail in position (fig. 86*a*) the author failed to notice that the distal marrow cavity was too wide for the nail.

The nail was driven in as far as the spongiosa of the epiphysis so at first the fracture was fixed (fig. 86*b*).

The wound was drained and closed but had to be opened shortly after the operation because of a venous hemorrhage. The vessel could not be located so the wound was tamponed. The primarily closed wound of the trochanter was not opened. A dorsal plaster splint extending up to the pelvis was applied, and a week later when the tampon was removed there was little secretion from the wound and the patient's temperature was normal.

Six weeks after the operation the patient had a fever; an abscess at the wound of the trochanter was widely opened. Soon after, an abscess was noted at the fracture cleft from which metal splinters and sequestra were removed. The limb was placed in a plaster cast after which the patient's fever subsided, but there was still a purulent discharge especially from the wound of the trochanter. This subsided very slowly.

Six months after the operation the patient's temperature rose again and he complained of pains above the knee joint. There was no effusion into the joint. The roentgenogram (fig. 86*c*) showed, in addition to a loosening of the structure next to the point of the nail, a

distinct rarefaction; therefore the limb was elevated, and the wound opened widely. After this was done the patient's temperature returned to normal.

When the purulent secretions had stopped, treading exercises in bed were begun but had to be stopped immediately because of pain at the fracture site and a rise of temperature. Three weeks later an abscess above the knee joint had to be opened; the joint was not involved and no rough bone was palpable. The rarefaction at the point of the nail did not increase, but distinct periosteal deposits were noticed along the medial side of the distal fragment (fig. 86*d*).

As the bone was obviously solid the nail was removed 8 days later. Sequestra were removed repeatedly from the fracture cleft and the healed wounds broke open several times. The patient was discharged from the hospital 17 months after the operation. The final result (fig. 86*e*) was a 9 cm. shortening of the limb, a stiffening of the knee joint, and a 50 percent impediment in the mobility of the hip joint.

This fracture should never have been nailed. Mobilization under anesthesia with wire extension and plaster cast would have been better. The fracture would have united quicker and much of the shortening would have been avoided.

It must always be borne in mind that when treating comminuted fractures the shortening will be greater if nailed than it would be if conservative treatment is used.

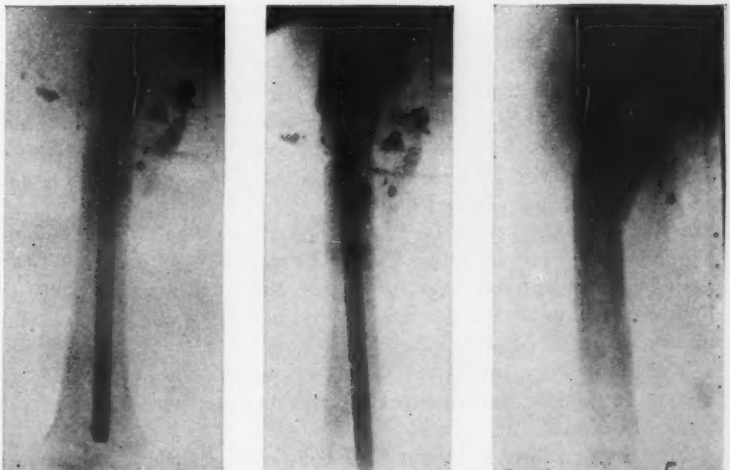

Figure 86 c, d, and e.

When infection occurs it is imperative to open the wound widely and to elevate the leg so that no accumulation of pus can take place in the distal fragment. The knee must be higher than the operative wound and the wound at the trochanter.

The author has suggested that the leg be kept in a horizontal position after the operation so that the drain becomes the deepest point; he has refused to use Braun's splint because with its use the wound at the trochanter would be the lowest point and the wound secretions could follow the nail in an upward direction. This is not true because the knee is generally in a lower position, especially if a dorsal plaster splint or a plaster cast in extended position is applied. In every case the knee must be kept in a higher position.

Figure 87*a* is a roentgenogram of a 10-month-old gunshot fracture of the left femur. When the patient was admitted the wounds had been healed for 3 months, but the fracture was still movable. As the right leg had been amputated it was not necessary to take a shortening into account so the proximal fragment was resected to the extent that the fracture could be easily reduced. The nail was driven into the spongiosa in order to secure a firm hold; the wounds at the fracture and trochanter were drained and the leg placed in a pelvic plaster cast. Four weeks after the operation the fracture was clinically solid (fig. 87*b*) and the wounds had healed; the plaster cast was removed and treading exercises in bed begun. Two weeks later the patient had fever and the wound at the fracture site broke open. A large abscess was discovered at the fracture site. This was caused by the loosening of the nail. Figure 87*c* shows rarefactions, lined by a distinct margin, next to the point of the nail.

The secretion subsided after the limb was put in a position of rest for a while. Exercises were again started but the patient's temperature rose immediately and there was an increased discharge of pus. A roentgenogram (fig. 87*d*) made 5 months after the operation showed a distinct formation of callus. Movements of the limb were then performed without pain and without causing inflammation of the wounds. Six weeks later (6½ months after the operation) the nail was removed. Figure 87*e* shows an irritation next to the rarefaction at the point of the nail. This rarefaction was due to mechanical influence because the limb was always put at rest and elevated in time to prevent an accumulation of pus in the distal fragment.

The following case illustrates a serious mistake; attention was always focused on the fracture cleft and no attention was paid to the point of the nail.

Figure 88*a* shows a 3-month-old compound gunshot fracture. It was in poor position and showed little formation of callus. Removal of the sequestrum and the nailing operation were done in one session.

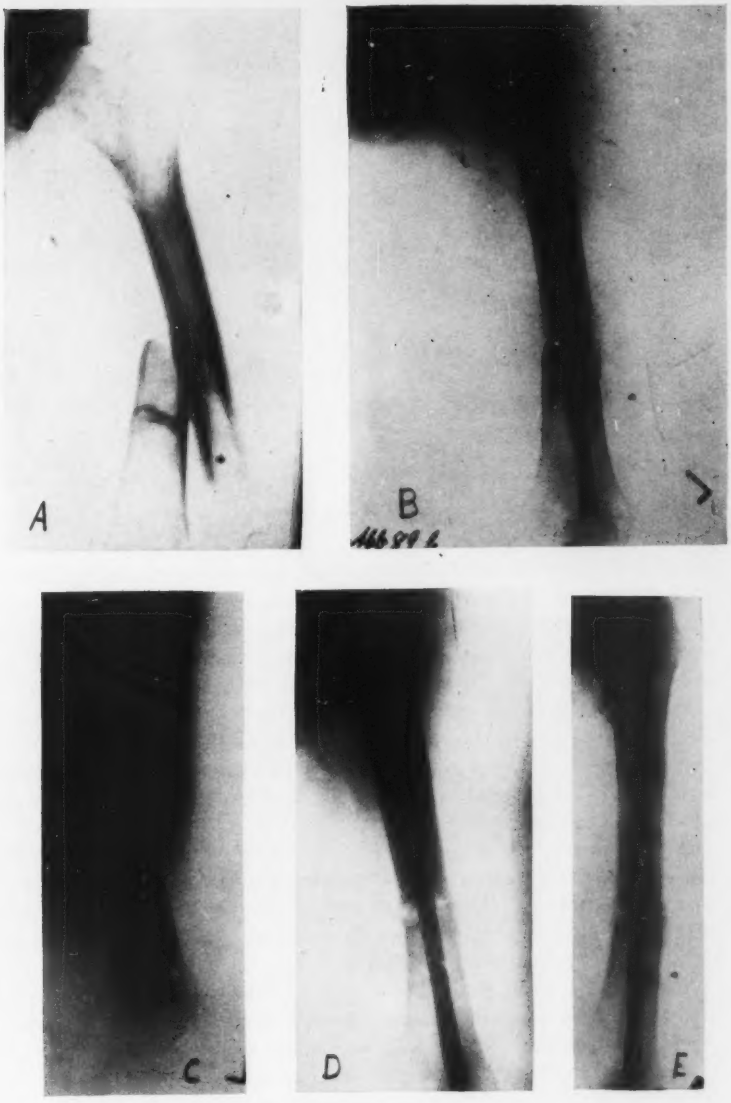

Figure 87.

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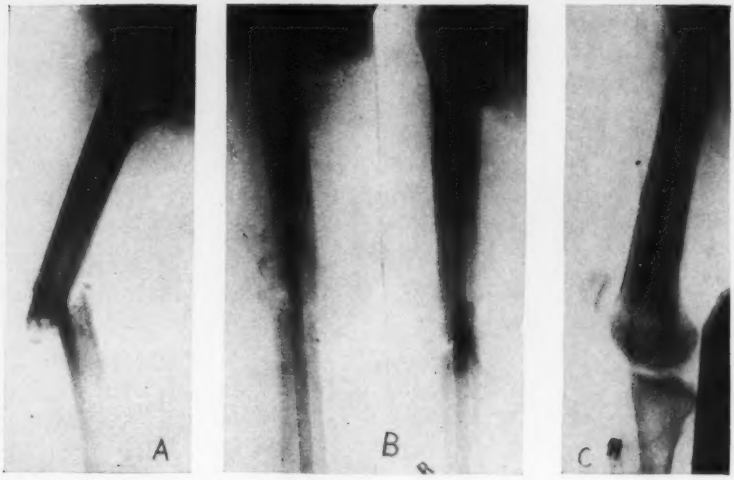

Figure 88 a, b, and c.

Because of the wide distal cavity the nail was driven into the spongiosa (fig. 88*b*) to obtain a relatively stabile osteosynthesis. Drains were inserted at the trochanter and the limb placed in a plaster cast. The patient's temperature returned to normal and the purulent discharge subsided soon after. The plaster cast was replaced by a plaster splint 4 weeks after the operation. The roentgenogram (fig. 88*c*) showed a distinct dystrophy of the condyles of the femur and a very subtle rarefaction next to the point of the nail, which we overlooked. Four weeks later several abscesses developed. These subsided when the limb was placed in a pelvic plaster cast.

A sequestrum was removed from the fracture site 6 months after nailing; the fracture was bridged over by callus (fig. 88*d*) so the plaster cast was removed. A purulent discharge still persisted 7 months after the operation so the nail was removed and the leg put in a plaster splint and kept in a horizontal position.

Two months after the removal of the nail a para-articular abscess was opened; rough bone was palpable above the lateral condyle and a perforation on the external side was noted (fig 88*e*). This perforation was still visible on a roentgenogram made 4 months later (fig. 88*f*) when the path of the nail was barely noticeable and the fistulae were closed.

The patient was discharged from the hospital 13 months after the operation. The fracture had united without shortening but the knee joint had stiffened considerably. The bones at that time were still

dystrophic and the site of the perforation was barely recognizable (fig. 88*g*).

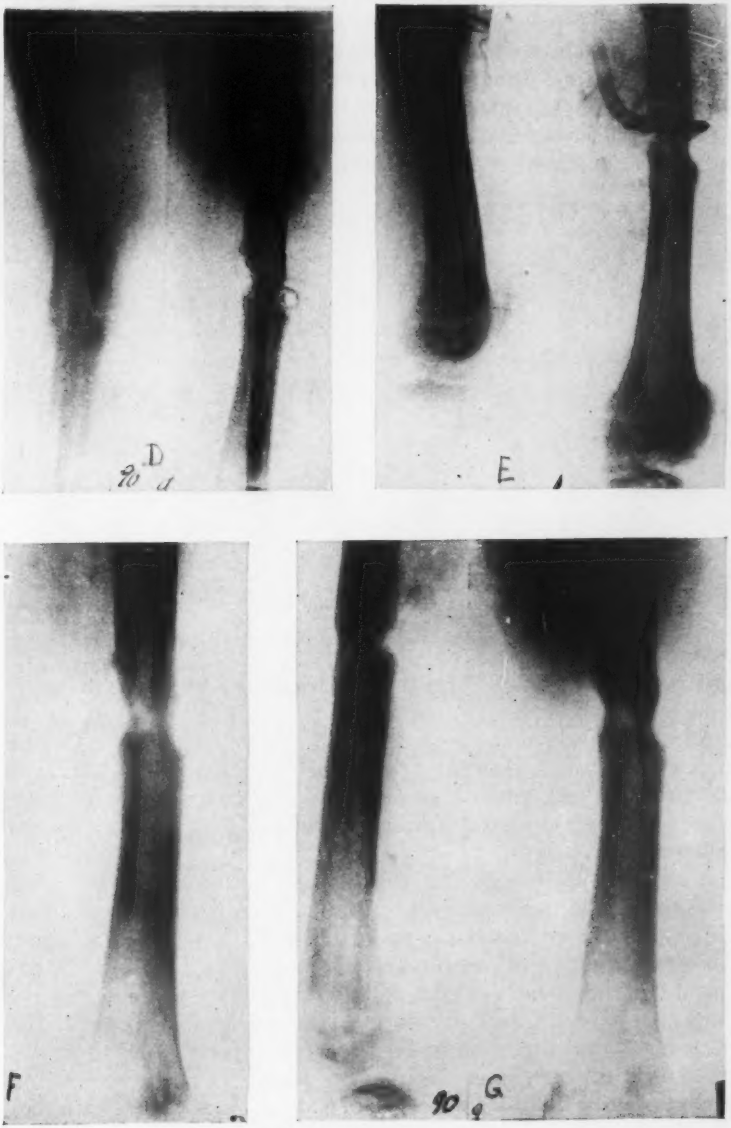

Figure 88 d, e, f, and g.

The point of the nail is seen only in one of the roentgenograms (fig. 88*c*) and that is probably due to a coincidence. When comparing illustration 88*b* and 88*d* it becomes evident that the nail had moved laterally and its point had probably pierced through the bone. The leg should have been elevated after the removal of the nail so the pus could have escaped through the bed of the nail thus probably preventing the spread of the infection.

Osteomyelitis was avoided in the two preceding cases because the limbs were put in plaster casts. Osteomyelitis is not to be feared if the

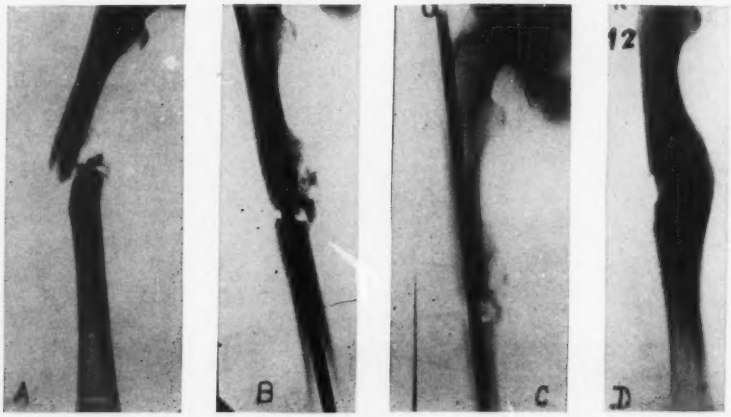

Figure 89.

nail has a firm hold and if the wounds are opened widely at the onset of infection.

An example which shows that the nail does not constitute a hazard in case of an infection of the wound and that the nail does not cause the spread of infection into the marrow cavity and also into the fracture cleft if the wounds are widely opened in time is shown by the following case.

A 6-month-old fracture (fig. 89*a*), the wounds of which had healed after the first wound treatment. An unsuccessful attempt to correct the position under anesthesia was made 8 weeks after the accident. Abscesses formed and there was a tedious secondary healing. Eight days after the wound healed a nailing osteotomy was performed because the fracture had solidified to a considerable extent. The wounds were primarily sutured but had to be opened 4 days later because of intense swelling. No pus was found. The fracture was in correct position but there was a gap of about 1 cm. at the fracture cleft (fig. 89*b*). Two weeks later the wound had healed without irritation and the patient began to use the limb so the fragments could be pushed

together. Eight days later the old fistula broke open again; it was enlarged and the secretion lasted for some time but there was no ejection of sequestra.

In spite of this, the limb was used without pain but the gap in the fracture still remained. A roentgenogram made 3 months after the operation (fig. 89*c*) showed a slight loosening of the structure at the fracture cleft, a cloudy formation of callus, but not an osteomyelitis. The nail was removed 6 months after the operation and the fistula still showed a slight secretion. After the removal of the nail the fistula healed.

An attempt to mobilize the knee joint, which was stiff before the operation, was unsuccessful.

The patient was discharged from the hospital 8 months after the operation. The fracture showed a bony union without shortening (fig. 89*d*), and the defect was completely bridged over (Boehler denies such a possibility), the hip and ankle joints were freely movable, and the knee joint was movable by 10°.

Postponing the operation in cases of fractures united with angulation does not reduce the chances of infection. In addition, restoration of normal conditions are more difficult because the callus is probably solid and this increases the chances of infection. The author believes (if the limited number of his patients warrants such conclusions) that the incidence of infection is higher in osteotomies performed later than 9 months after healing of the wounds than in those operated earlier. This is especially true in pseudarthroses of old fractures. The explanation is probably that the wounds were not sutured in operations performed shortly after healing.

The poor results of nailing operations have intentionally been given so much space because only by mistakes can we learn and thus come to perfection. Sincerity serves the cause and the patients more than a list of successful operations because this might lead the beginner to underestimate the difficulties.

The results obtained by the marrow nail operation are superior to any other method; all fractures, including pseudarthroses a year or more old, will unite provided the osteosynthesis is stabile.

One instructive example will be given in this connection.

A gunshot fracture of the left femur sustained on 27 December 1941, was first treated by removal of numerous splinters and the limb put in an extension bandage for 5 months. In March 1942 an osteosynthesis by use of a Lane's plate was done but this had to be removed 3 weeks later because infection occurred. An extension bandage was again applied and kept on until June 1942 when the leg was put in a pelvic plaster cast. In October 1942 a fixation was attempted by means of ivory pins but the wound became infected again.

The gunshot wounds had been closed since February 1942 but no bony union developed.

In June 1942, when the patient was readmitted, the wounds were healed but there was abnormal mobility at the fracture site, a shortening of 6 cm., the knee was stiffened in an extended position, and the patient could walk only with a hinged splint (fig. 90*a*). On 8 July 1942 a marrow nailing operation was performed with exposure of the fracture site. The ivory pins and remnants of wire were removed and the callus resected as sparingly as possible. A drain was placed in the approximation sutures and the leg put in a splint. Osteosynthesis was stabile (fig. 90*b*) and the wounds healed. On 15 July, 1 week after the operation, the patient started exercises of the knee joint and on 8 September he was discharged from the hospital. The patient walked well without limping with a high heel shoe and the roentgenogram (fig. 90*c*) showed a distinct formation of callus and no rarefactions at the point of the nail.

The fracture pushed together and the nail pushed out at the trochanter. On 7 March the fracture had united (fig. 90*d*) and the nail, which had pushed farther upward, was removed. The patient was discharged from the hospital 10 days later. The patient's stay in the hospital after the nailing operation was 73 days; unemployability, 125 days.

The course, the duration of stay in the hospital after the marrow nailing, and unemployability correspond in every respect to what is known in the nailing of fresh fractures; the same was true for all other aseptically healed cases.

In smooth transverse fractures, shortenings could be avoided in all cases, and the same is true with regard to impediments of the joint in fractures 3 months old or less. If the joints had stiffened before the operation considerable improvement was achieved in all cases with an aseptic course. The shortenings in osteotomies were greatly improved in all cases. These are results which cannot be obtained by any other method.

Unfortunately the author had no opportunity to use penicillin but he feels that the use of this drug will greatly reduce the danger of infection in the treatment of fractures by the open nailing.

It is not always possible to determine whether an osteosynthesis will become stabile or not and it is dangerous to wait; especially if the bone tends to unite in bad position. If it becomes evident during or after the operation that only a relatively stabile osteosynthesis will be obtained by driving the nail in as far as the spongiosa of the epiphysis, it will be necessary to put the limb in a plaster cast immediately. If infection develops the fixation must be maintained until the fracture has reached an advanced degree of solidification.

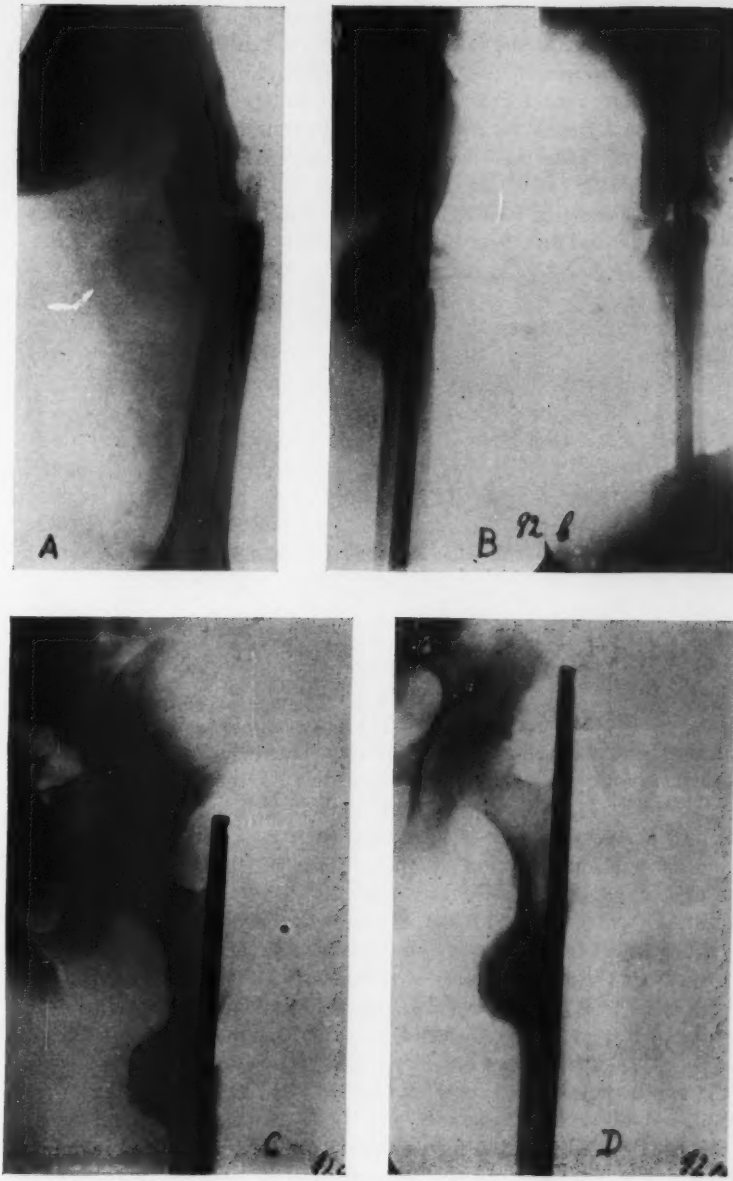

Figure 90 a, b, c, and d.

If no infection develops it will be necessary to check the patient closely for 6 to 8 weeks after the operation, as this is the time when the nail will begin to loosen in the spongiosa. This condition is indicated by rarefactions next to the point of the nail. If the patient complains of the slightest pain or if swelling occurs, immediate bed rest is imperative. This must be strictly observed because of the possibility of infection and all its complications.

The advisability of nailing while the wounds are still discharging pus would depend on whether or not the nail would spread the infection. This, generally, is not the case, as was demonstrated by the fact that osteomyelitis did not occur in any compound chronically infected fractures treated by the author, including a fistulous fracture of the femur in which the nail was driven into the knee joint. Although an irritation was observed in the knee joint, this condition disappeared in 3 days.

As improbable as it may seem, the infection is obviously wiped off the smooth surface of the nail upon entering the scar tissue which closes the marrow cavity. If any infection is spread it will be so slight that the marrow cavity, with its great number of blood cells, can easily cope with it. This mechanical cleansing seems to be almost perfect if the nail enters through solid bone. The center of infection is held up by a dam of granulations as soon as the acute stage is overcome. If this granulation is pierced by the nail it will close again in a very short time, thus affording full protection, provided the nail has a firm hold.

Because of these facts the author endeavored to avoid resection of the fracture ends and severance of the periosteum. He adopted the same procedure as in closed nailing: driving the nail in from the trochanter and not from the fracture cleft as is customary in open nailing. When the nail reaches the fracture cleft the fracture is properly reduced (traction by an assistant is usually sufficient) and the nail or guide rod is directed into the distal marrow cavity with the finger which is introduced into the wound. This method offers no difficulties in fractures of the tibia and humerus, but in fractures of the femur conditions are more difficult and this painstaking is worth while. By following this procedure subsequent formation of sequestra was avoided. Whenever the nailing was performed from the fracture cleft, and especially if the fracture site had been widely exposed, the patient had fever and a chronic infection with formation of sequestra persisted.

If it is decided to nail a fistulous fracture that has united in faulty position the operation should be performed in two sessions: first an osteotomy (refracture) of the fracture and extension fixation until acute sequelae are overcome; then, if these measures are not satisfac-

tory as to reduction and fixation, and only then, the nailing may be performed, but not earlier than 3 weeks after fever has disappeared.

We have nailed seven chronically infected femur fractures because of the formation of sequestra, abscesses, or pneumonia, and the impossibility of fixation regardless of position. Only in such emergencies do we advocate stabile osteosynthesis with the marrow nail. The perfect fixation which can be achieved with the nail has shown surprisingly good results in fighting infections and improving the general condition of the patient. This is shown in the following case.

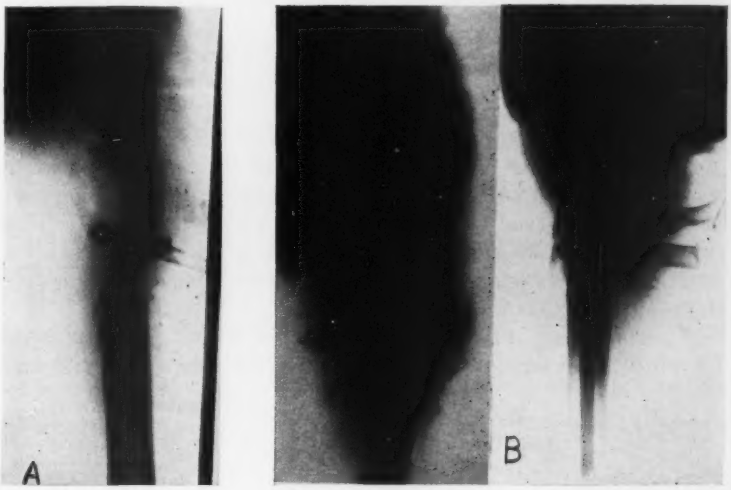

Figure 91 a and b.

Several abscesses had been opened in this 43-day-old fracture of the femur and the patient still had a fever of 40° C. The wire extension did not prove satisfactory because the patient was very nervous (fig. 91*a*). As we had been able to separate a few loose splinters from the wound it was decided to nail the fracture. The palpable splinters and sequestra were removed without opening the wound very wide. The guide rod was then introduced into the proximal marrow cavity, under roentgenogram control, after placing several needles for guides (as is done in closed marrow nailing), after which the nail was driven in. When the nail had entered the marrow cavity about 6 cm. the guide rod was removed and the nail driven in until it could be felt at the fracture cleft. The nail was then directed with the finger and could be easily introduced into the distal fragment after appropriate reduction was made by an assistant. The nail was then driven into the spongiosa of the epiphysis which gave it a firm hold

(fig. 91*b*). The operative site and the trochanter wounds were then drained (the former posteriorly) and the limb was kept in a splint in a slightly elevated position.

The patient still had a fever the day following the operation, but 5 days after the operation his temperature returned to normal and he was free from pain. Recovery was rapid but the wound infection persisted for 4 weeks. After that the infection subsided and 8 weeks after the operation the patient started moving the limb. After 3 months he was ambulatory. Several abscesses were opened later and 6½ months after the operation a sequestrum the size of a cherry seed was removed, and the secretion ceased.

A roentgenogram made 5 months after the operation (fig. 91*c*) showed good callus formation so the limb was subjected to weight bearing.

Nine months postoperatively the nail was withdrawn, although a fistula was present. The leg was again put in a splint for 2 weeks; several sequestra were ejected and the fistula closed. The patient was then discharged from the hospital. The hip and ankle joints were freely movable and the flexion of the knee was up to 60°.

Six months later the patient fractured the patella of the same leg; this was fixed by wire suture.

The shortening of the leg amounted to about 9 cm., about 50 percent of which was compensated for by special footwear. Hip and ankle

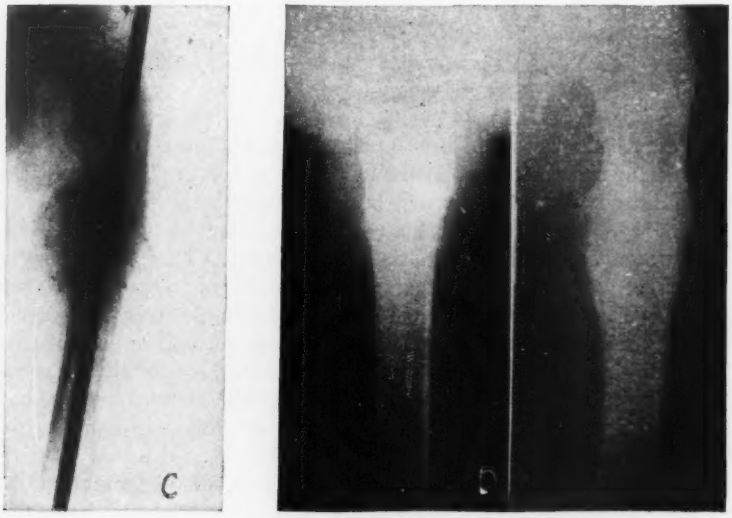

Figure 91 c and d.

joints were free; flexion of the knee 80° to 180°; and the patient was able to walk without a cane. The fracture united with no formation of cavities or sequestra (fig. 91*d*).

The sound leg will be shortened at some future time, using the marrow nail.

The advocates of conservative treatment may maintain that the fracture would have united without the use of the nail, but the marrow nail meant an alleviation of pain and it appears doubtful whether such good mobility of the joints would have been obtained by conservative treatment. More than one-third of the gunshot fractures of the femur treated by Boehler had a mobility of the knee joint of less than 60°.

Of chronic infected fistulous fractures, 6 healed without any impediment; in 3 cases there was more than 90° mobility of the knee; in 3 the fractures united without shortening; 2 had shortening of 1 cm.; and 3 comminuted fractures united with shortenings of from 3 to 6 cm. Only 8 cases came in for treatment earlier than 2½ months after injury (a time when existing impediments of joints seems to be reparable).

In the remaining 18 cases of compound fistulous fractures of the femur the injuries dated back 5 to 12 months. After such a long time it was impossible to restore full mobility to the joint, but definite improvement was achieved in all of these cases.

The time spent in the hospital can hardly serve as a basis for comparing the value of the marrow nail method with the conservative method because this depends entirely on the type of fracture. In cases treated by the author, the time varied between 180 and 450 days. It was surprising that the stay in the hospital was particularly long in fractures that had been opened widely and in which the guide rod or nail had been introduced from the fracture cleft. These cases were characterized by abscess and sequestra formation.

A compound chronically infected fistulous fracture in good position as shown in figure 92*a* should not be nailed. This fracture was 7½ months old and the roentgenogram showed a distinct callus formation. Fixation would have been just as quick by using conservative methods and in all probability the shortening of 2 cm. and impeded abduction of the hip joint and limited mobility of the knee which resulted from the nailing would have been prevented.

Although the nail had a firm hold in the distal fragment (fig. 92*b*) the osteosynthesis was not stabile enough to permit early use of the limb. Another reason why the limb could not be used early was because sequestra continued for a long time. Ten months after the operation the fracture had healed enough to remove the nail, and 3 months later the fistulae were closed (fig. 92*c*).

Figure 92.

If an ordinary Unna's extension bandage had been used, instead of nailing, better results would probably have been obtained with less delay. It is therefore not advisable to nail compound fistulous fractures that are in good position with callus formation; but if the position is bad and there is danger of a faulty union, as was the case in a 5-month-old infected fracture shown in figure 93*a*, marrow nailing should be done.

In this case sequestra and shell fragments were obviously the reason for infection, therefore exposure of the fracture was necessary. After removal of the sequestra the fracture was completely movable and a roentgenogram (fig. 93*b*) showed a threatened pseudarthrosis. The infection ceased soon after the operation and the general condition of the patient improved. His temperature was normal 4 weeks postoperatively and motion of the limb was started. A small sequestrum was ejected later and 5 months after the operation the fracture had united to such extent that the patient began to use the limb (fig. 93*c*). The nail was removed 3 months later (fig. 93*d*) and the fistula soon closed. Two small sequestrae were ejected later. The final result was a shortening of 4 cm. (the limb was 8 cm. short before the operation), 30 percent impediment in abduction of hip joint; and 100° to 180° mobility of the knee joint.

From experiences and knowledge gained from the preceding cases the author draws the following conclusions:

If an old gunshot fracture of the femur has united in bad position, nailing osteotomy is indicated and should be performed as soon as possible provided a stabile osteosynthesis can be obtained.

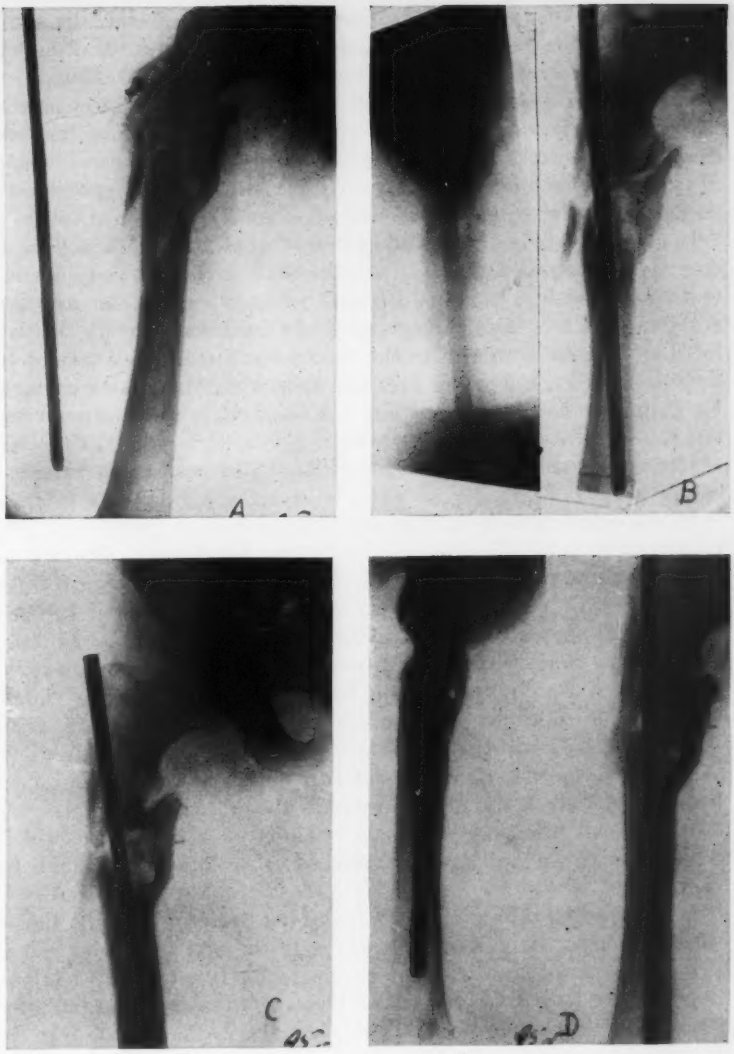

Figure 93 a, b, c, and d.

Compound fractures with splinters to be removed and where the fracture must be pushed together, should not be nailed. Nailing has no advantages in these cases and may cause considerable damage.

If a stabile osteosynthesis cannot be obtained, the operation should be performed in two sessions. First, an osteotomy with wire extension. If no infection develops after correcting displacements and after the damaged tissues have healed (generally after 2 or 3 weeks) the open marrow nailing can then be performed.

In old gunshot fractures of the femur where there is deficient callus formation and pseudarthrosis, and the wounds have healed, marrow nailing may be done provided a stabile osteosynthesis can be expected.

When only relative stability can be obtained even though the nail has been driven in as far as the spongiosa, the fracture should be mobilized under anesthesia first and then a wire extension applied. Nothing more should be done until the shortening has been overcome and the injured soft parts have healed.

If the fracture becomes reinfected it will be necessary to treat it conservatively.

If the osteosynthesis is only relatively stabile a plaster cast may be necessary until the danger of infection has passed. Special attention will be necessary when the limb is first used (about 6 to 10 weeks after the operation), because at this time the nail becomes loose in the spongiosa. Rarefactions next to the point of the nail indicate this danger. Strict bed rest must be instituted if the patient complains of the slightest pain; if fever develops then bed rest should be maintained until the fracture is bridged over by callus. If this is neglected there is danger of reinfection with all its complications.

As a rule the wounds at the fracture cleft and trochanter should be drained. Recently healed wounds should be closely observed because if an infection occurs the wounds must be opened widely without delay and the limb immobilized to avoid a sag in the distal fragment.

A chronically infected fistulous gunshot fracture may be nailed without danger of infection spreading to the marrow cavity. It is important, however, that the osteosynthesis be absolutely stabile. Special care must be taken not to break the protective granulation dam of the infection center and the nail must be introduced into the proximal marrow cavity from the trochanter, as is done in simple fractures, and not from the fracture cleft.

Compound fractures and fractures in which a stabile osteosynthesis cannot be obtained are not suitable for nailing.

Nailing of fistulous fractures offers many advantages, but it is important to be extremely careful about the indications. The most important is the possibility of obtaining a stabile osteosynthesis.

When this condition can be assured nailing can be done if a satisfactory fixation of the fracture cannot be achieved by conservative methods or if a pseudarthrosis exists or threatens to develop. When formation of sequestra makes the exposure of the fracture site necessary the nailing operation can be performed at the same time if the general condition of the patient is good and the fracture lends itself to nailing.

Intensely purulent fractures, regardless of position, should be nailed only if it is impossible to obtain satisfactory fixation necessary to combat the infection or if formation of sequestra or tubular abscesses makes an operation necessary.

Nailing of gunshot fractures of the femur should not be performed when acute infection exists (marrow and tissue clefts not closed by protective granulation), nor if the general condition of the patient is not good. It must be borne in mind that nailing of a femur fracture is a major operation.

The stabile osteosynthesis with the marrow nail has advantages over all other known methods, even in chronically infected fistulous gunshot fractures when the indications are carefully considered.

To be concluded in the February issue of the JOURNAL.

Spontaneous Rupture of the Spleen in Relapsing Fever

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CLINICALLY, rupture of the spleen may be considered as either spontaneous or traumatic. The latter may be further divided into rupture of a healthy spleen and rupture of a spleen revealing pathologic changes. A review of the literature fails to reveal any authoritative reports of spontaneous rupture in a healthy spleen. This conclusion is supported by Lundell's (*1*) study of 20 cases designated as spontaneous rupture of a healthy spleen; none of his cases clearly demonstrated that a healthy spleen might rupture spontaneously. Spontaneous rupture of a diseased spleen is common. Alterations of the spleen that predispose to rupture occur especially in infectious or toxic conditions of the body with enlargement of the spleen and softening of the parenchyma referred to as acute splenitis or acute splenic tumor (*2*). This condition, coupled with the loss of protection suffered when the enlarged spleen extends below the costal cage, exposes the organ to minimal though potentially serious trauma. This trauma may be either external or internal. In a number of patients the rupture has appeared to be spontaneous.

Rupture of a healthy spleen occurs after severe direct or indirect trauma; doubts regarding the cause of the rupture should arise only in exceptional cases. Traumatic rupture of a diseased spleen, however, occurs only after minimal trauma. The exposed position of the enlarged friable spleen subjects it to the dangers of trauma incident to such stresses as sudden motion, coughing, sneezing, or defecation. The danger of external trauma is obvious.

Rupture, whether spontaneous or traumatic, occurs more readily in the presence of such anatomic changes as: (*a*) abnormal mobility of the spleen; (*b*) perisplenic adhesions that fix the organ to adjacent structures; (*c*) extreme congestion; and (*d*) loosening or destruction of the parenchyma of the spleen as the result of systemic and local infections, circulatory disturbances, necroses, or tumors. Among the

infectious diseases, malaria is the chief cause of spontaneous rupture of the spleen. Leighton, in 1939, compiled 73 such cases from the literature (*3*). Rupture has not infrequently occurred in therapeutically induced malaria (*4*). Typhoid fever is the next most frequent cause of spontaneous rupture. It has also been reported in paratyphoid fever, relapsing fever, cholera, tuberculosis, syphilis, and in various types of septic or toxic conditions.

Circulatory disturbances, either general or local, may be major factors in the occurrence of rupture of the spleen in pregnancy, parturition, puerperium, hepatic cirrhosis or carcinosis, cancer of the pancreas, portal thrombosis, isolated thrombosis of the splenic vein, and infarct of the spleen. Several cases have been observed in the leukemias, hemophilia, and thrombopenia. Referring to the infrequency of splenic rupture, whether spontaneous or traumatic, Krumbhaar (*5*) reports only 3 such cases in a series of 10,000 autopsies. As to the incidence of rupture of the spleen in cases of relapsing fever, Beveridge (*6*) reports a series of 116 patients with a mortality of 7 percent; in none was rupture of the spleen noted.

CASE REPORT

A 33-year-old man, who had been on duty in Korea for 6 months, was admitted to the 382d Station Hospital on 26 December 1948, complaining of general malaise, anorexia, frontal headache, chills, and fever of 3 days' duration. He had remained on duty until the day prior to admission, when, because of these complaints and a dull aching pain in the right upper abdominal quadrant, he stayed in his quarters where a physician saw him and gave him mild anodynes and sedatives. On admission to the hospital he stated that his bowels had been somewhat looser than usual but normal in color. He had had no nausea or vomiting, but had noticed that in the preceding 24 hours his urine had been slightly darker than usual.

His temperature was 101.8° F.; pulse rate, 90; respirations, 22; and blood pressure, 115/75. He was slightly obese and did not appear to be in pain. There was no jaundice or cyanosis. The liver and spleen were not palpable. There was slight tenderness on deep palpation in the right upper abdominal quadrant. The physical examination was otherwise normal. A tentative diagnosis of the prodromal phase of infectious hepatitis was made.

The patient was put to bed and given intravenous fluids. By early evening he was feeling much better and eating a soft diet. Urinalysis revealed 2 plus albumin, a negative reaction for bile, and normal microscopic findings. At 2200 he complained of a pain in the left upper abdominal quadrant. He appeared apprehensive and his temperature was 98° F.; the skin was cold; the pulse was rapid and thready; and the blood pressure was 36/30. There was an ill-defined abdominal tenderness without spasm or rigidity. Intravenous *d*-glucose solution was given. At 0100, 27 December, he appeared to be in shock. His spleen was not palpable. At 0245 his blood pressure was 86/20 and he appeared to be recovering from shock. At that time the spleen was palpated 3 fingerbreadths below the left costal margin. It was soft and tender, and the patient complained of pain in the left upper abdominal quadrant accentuated by respiration. A friction rub was present. A diagnosis of splenic infarct with

possible rupture of the spleen was made. Three units of plasma were given with *d*-glucose in saline solution. At 0345 his blood pressure was 95/50. At 0530, the patient became suddenly dyspneic and again showed signs of severe shock. He was placed in an oxygen tent and given stimulants and analeptics. The pulse became impalpable and the blood pressure fell rapidly. He died at 0630. The spleen did not increase in size in the last 3 hours, but the abdomen felt doughy and seemed to increase in size. The clinical diagnosis was spontaneous rupture of the spleen, with severe intraperitoneal hemorrhage, cause unknown.

Pathologic findings.—The abdomen was protuberant. The peritoneal cavity contained about 5,000 cc. of recently clotted blood and thin bloody fluid; most of the clotted blood was in the left upper abdominal quadrant surrounding the spleen. The diaphragm was very high bilaterally. The spleen weighed 315 gm. and was large, soft, and pulpy. In the anterior midportion there was a ruptured area 3 to 6 cm. wide, which extended inferiorly to involve most of the pole. The cut section was blue-purple with indistinct and absent markings, and much soft semiliquid material. There was no evidence of perisplenic adhesions or any disease in the spleen. The coronary and systemic arteries showed minimal atherosclerosis. The lungs showed acute congestion. The liver was large and congested with a suggestion of minimal fatty change. The microscopic examination of the spleen and liver revealed numerous spirochetes identified as *Borrelia recurrentis*. The peripheral blood smear also showed many spirochetes.

Louse-borne relapsing fever is present among the natives in Korea.

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Psychiatry in General Practice[1]

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EVERY physician must consider the influence of emotional factors in the patient. More than any other, the general practitioner has considered the feelings and the personality of the sick, and his efforts along this line have been rewarded by the loyalty of his patients. So many physicians in the Army and Navy saw the successful integration of psychiatry with general medicine and surgery, that there has been an increasing desire to learn more about psychiatry and its contribution to medical practice. The average practitioner meets a psychosis only in the exceptional case, although about 1 in 15 of the general population is apt to develop a psychosis, and up to 80 percent of the patients seen in a general practice will complain of symptoms which might be diagnosed as psychoneurosis.

A psychoneurosis is essentially a subconscious attempt of the individual to adjust to his environment, while a psychosis is the failure to make that adjustment, and therefore a flight from reality.

In spite of enlightened medical teaching, there is still a general feeling among many physicians that all pathologic lesions are attributable to some physical cause—trauma, bacterial invasion, or deteriorative change. There is a preponderance of scientific evidence which proves that not only can physiologic function be altered, but actual lesions of tissue can be brought about by psychically produced impulses. But to cause anatomic damage these impulses must be intense and long-sustained.

Situations in the environment are observed by the sense organs and are transformed into nerve impulses. Visual impulses are conducted by the optic nerve to a way-station in the lateral geniculate body, then to the visual centers in the occipital lobe, and then conducted to association centers in the frontal lobe. Similarly, the auditory impressions travel by way of the cochlear nerve, pass a way-station in the medial geniculate body to reach the auditory centers in the temporal lobe then they are conducted to the association centers in the frontal lobe. These, combined with other sensations such as taste, smell, and touch, allow the individual to get an impression of his environment.

[1] Presented before the Nassau County Medical Society.

As the individual interprets these sensations, various emotional states are produced. If the dominant state is fear, anger, or resentment, reaction mechanisms may be set in motion, which in the primitive state may have been advantageous for the survival of the individual. But in modern life, the manifestations of these emotions may be unacceptable and so are suppressed, and inner tension is likely to develop. This tension cannot long be continued without release, and the release may take the form of neurotic symptoms.

As medical students we studied frogs in order to learn something about physiological processes, but we can learn something more from those frogs. A frog can do very well minus a cerebrum. Confine a decerebrated frog and a normal frog under a glass jar and let flies into the jar. The frog that lacks a cerebrum will catch many more flies than his normal companion. In fact he will catch all the flies, and the other frog none. The cortex of the normal frog evidently makes him subject to inhibitions and fears. He devotes his time and attention to the problem of getting out of the glass jar. The decerebrated frog does not recognize the existence of such an intellectual or philosophical problem. He takes things as they are and is quite content to live a life on a lower plane. Hence he devotes himself unreservedly to catching flies. The brainless frog grows healthy, while the intellectual frog fears, speculates, philosophizes, and starves himself to death. If he were a human, he would develop a neurosis, or an exophthalmic goiter, or else become insane.

Pavlov's (*1*) work with dogs, demonstrated that if the same stimulus was repeated a sufficient number of times under certain environmental conditions, conditioned reflexes were developed, and the dog was unable to discriminate between changing environment or stimulation. In other words, the dog failed in his adaptation and this failure to interpret the stimuli correctly resulted in distressing emotional uncertainty, confusion, fear, and frustration, i. e., a neurosis.

Modern psychiatry is based on the fundamental contributions of three men. The physiologist, Cannon, who was one of the first to study the physiological manifestations and ramifications of the emotions. He clearly showed how the glands of internal secretion were tied up with our feelings. Pavlov, as stated before, conducted ingenious research on the nervous system integrations involved in the process of learning, habit formation, and conditioning. Freud traced the origin of many emotional illnesses to childhood and infantile experiences, and investigated the complex conditions that influence the individual in his family life. Although these three physicians enunciated the fundamentals of psychosomatic interpretation, numerous other psychologists and physicians have made many additional contributions.

CLINICAL DIAGNOSIS

Of 1,000 patients studied at the Lahey Clinic, 406 were found to have nervous problems of clinical importance (*2*). In 272 patients, the complaints were purely neuropsychiatric; and in 134 a combination of physical and significant neuropsychiatric disorders were found. In this latter group, 39 had independent and unrelated physical and nervous problems; in 73 the physical disorder was aggravated or provoked by a primary nervous state, and in 22 the nervous state was considered to be secondary to the physical disorder.

Yet, on the other hand, to try and single out certain diseases as psychosomatic is futile, as every disease is essentially psychosomatic, because both psychological and somatic factors have a part in its cause and influence its course. Thus, even though a disease may appear to be restricted to a physical disorder, such as tuberculosis, appendicitis, or myocarditis, even these illnesses might be considered to have a mental component. The degree of mental and nervous reaction will depend on the basic personality of the patient as well as other factors, including the seriousness of the illness, the degree of suffering, uncertainty regarding the outcome, interference with work and other plans, and financial loss.

Further analysis showed that of the 406 neuropsychiatric patients there were 3 cases of psychosis and 7 borderline cases, including 5 cases of mental depression. In 75 patients a clear-cut diagnosis of psychoneurosis was made. Of the remaining 321 patients, neither the diagnosis of psychosis nor of psychoneurosis was made.

The diagnosis of a nervous condition should not depend merely on exclusion of organic disease; in fact, 1 in 7 of the above patients had both physical and nervous disorders of importance. Recognition must depend on observation of the characteristic manifestations of the nervous disorder itself. Some of the complaints are pathognomonic, such as globus hystericus and sighing respiration with difficulty in getting a satisfying breath. Signs of nervous tension may be bitten finger nails, flushing of the face, and variable tachycardia. The fatigue resulting from nervous tension has special characteristics. These include variability unrelated to physical activity; it is usually worse in the morning, decreasing after activity. Some patients complain of worries, low spirits, inability to enjoy work and social relationships, difficulty in making decisions, and disturbing mental conflicts. In many patients a background of constitutional inadequacy, and a family history of "nervous breakdown" can be found. The onset of complaints is usually vague, and frequently dates back to childhood.

Among the patients in whom there were nervous and emotional disorders, the diagnosis of psychoneurosis was made in 75 (neuras-

thenia, 60; anxiety neurosis, 10; hysteria, 5). The diagnosis of a benign nervous state was made in 321 cases. In 104 of these the term applied was chronic nervous exhaustion. The term nervous fatigue was used to describe the same condition when shorter in duration and less severe in degree. This diagnosis was made in 71, making a total of 175 cases of nervous exhaustion or fatigue, which in the service was called combat or operational fatigue. The diagnosis of simple anxiety was made in 73, nervous instability in 39, psychogenic gastrointestinal disorders, including irritable colon and nervous indigestion in 12, neurocirculatory asthenia in 10, tension headache in 11, and neurodermatitis in 1.

SERIOUS MENTAL DEPRESSION

Reactive depression is a common problem in general practice. It was the diagnosis in 5 of the 1,000 patients seen. The common manifestations are low spirits, weeping, insomnia, self-reproach, feelings of guilt, slowing of the patient's normal action, inability to make decisions, and, sometimes, morbid ideas regarding disease and symptoms. These individuals frequently express a fear of losing their minds, and are potentially suicidal.

When threatened suicide is evident, the physician must decide without delay whether the patient is potentially suicidal or not, and if so, must be able to take appropriate action. Most bona fide suicidal attempts and successful suicides occur either in the course of a severe depression or in catatonic excitement (*3*). In the latter condition, suicide is likely to be a sudden, impulsive affair and attacks on others may occur as well. A sufficiently depressed person kills himself with deliberate and considered purposefulness. Such a decision may be carried out so rapidly that no opportunity for prevention may appear. More commonly the patient broods over the matter of self-destruction for a considerable period of time and may or may not apprise others of what is in his mind. It is not true that one who talks suicide never does anything about it. A serious suicidal intent may be strongly suspected when the patient is obviously sad and depressed but not too retarded in action, does not cry, expresses unshakable hopelessness, or speaks of suicidal ideas more or less matter of factly without seeming to be dramatic or to overdo it. Suicidal threats made in a dramatic manner are apt to be attention-getting gestures of a hysterical personality and while these people often make actual attempts at suicide, they are careful not to complete them. A patient extremely depressed and retarded may have insufficient drive to carry out self-destruction so that suicide is most likely to occur if a patient is going into or coming out of a deep depression. Thus, when

a patient is recovering from a reactive depression with the help of shock treatment, this complication has to be watched for.

A general practitioner frequently first sees such patients when they complain of various somatic dysfunctions which we will discuss later. They complain of profound lack of energy and a feeling of being no longer able to cope with day-to-day activities. The practitioner's contribution to the handling of such cases is his early recognition of the suicidal potentiality and prompt psychiatric treatment.

TOXIC PSYCHOSES

It would appear obvious that insomnia requires medication, but this is erroneous. While sedative and hypnotic drugs have an important place in the treatment, they should be closely supervised, as in psychotic or neurotic individuals these drugs may actually increase the symptoms. Only rarely is the administration of a hypnotic necessary for more than a few days at a time.

Insomnia should be differentiated from general sleeplessness in that the person with insomnia is unaware of the deeper causes of his affliction. Most persons who have difficulty going to sleep have unconscious death fantasies of long duration. The patient avoids going to sleep to keep himself from terrifying or disturbing dreams. The person very definitely is afraid to go to sleep. When he does go to sleep, the next day he refuses to admit that he dreams.

The symptoms and signs of intoxication by the bromides or barbiturates may appear insidiously and may be obscured by the patient's preexistent complaints and thus go unrecognized until a dangerous toxic state has been reached. This may be characterized by restlessness, confusion, disorientation, and sometimes hallucinations. A rash may appear. In all cases where a delirious reaction without obvious cause is seen, these drugs should be suspected. Not infrequently in a psychiatric practice we have patients referred who show a chronic confusional state with drowsiness and apathy, an acute delirium, or even a profound shocklike state with marked depression of the vital centers, which have all been caused by overdosage with barbiturates. On the other hand, it should be remembered that in those habituated to large doses of barbiturates, the sudden and complete withdrawal of the drug is inadvisable. Not only will distressing anxiety symptoms result but not infrequently convulsions may occur when the long-standing cortical depressant influence is suddenly removed.

In cases of delirium tremens, the treatment of the underlying alcoholism should await the clearing up of the toxic symptoms. It should not be forgotten that mental symptoms can be caused by the sulfa drugs or the lack of the vitamins. Also, a woman's underlying

tension may be relieved by the administration of estrogen, but, in some cases, the tension is made worse.

ACUTE ANXIETY

Acute anxiety states or panic reactions may be the response to a more or less sudden activation of an underlying emotional conflict by internal or external influences. Often anxiety states are the precursors of a severe psychosis of a schizophrenic type, such as a catatonic excitement. The patient may consult the physician because of the "jitters," palpitation, giddiness, headache, and may have difficulty telling the physician about his real fears of losing his mind, and possible concern about homosexuality. The busy physician may pass off the patient's complaints lightly and send him away with a prescription for phenobarbital and the admonition to "forget it." Unfortunately, the patient may be able to "forget it" only by becoming psychotic. If the patient is encouraged to talk about these hidden fears to a calm and sympathetic listener, a psychosis may be averted. The physician may reassure the patient about the unreality of his worries and point out the normality of his impulses. Such expenditure of time may spell the difference between sanity and insanity.

A recent report (*4*) stated, that of 6,000 industrial workers, 20 percent of their working time was lost in acute anxiety, and that during this period they caused more than 50 percent of all accidents. One-third of the workers studied had two-thirds of all the accidents. These figures indicate that the majority of accidents constitute a psychosomatic problem. Last year, accidents killed 100,000 persons and maimed about 400,000, with an estimated cost of $5,000,000,000. Significant also is the fact that accidents, not disease, cause more child deaths than any other cause. Accident-proneness deserves closer attention as part of a distinct clinical syndrome. It has been estimated that about 80 percent of all accidents have their origin in personality disorders.

UNDERSTANDING PERSONALITY

In the understanding of personality it is necessary to understand the early expression of tension. Unsatisfied hunger, fear, anger, insecurity, overstimulation of the bowel or urinary-genital area, and painful sensations may build up a tension in the individual, and require emotional release. These emotions are early, not always clearly differentiated, and find common pathways of expression in unorganized hyperactivity of the skeletal musculature. The various bodily systems, such as: the respiratory, circulatory, gastrointestinal, genito-urinary systems, and the skin and mucous membranes may vig-

orously participate in these reactions. Later, the emotions of fear, anger, and depression become differentiated by stimuli organization, thought content, and type of activity. All of these involve tense physiological disturbances, and these disturbances continue as a chief outlet or expression of emotions. These physiological disturbances acquire a pattern through repetition, and often become characteristic of the individual. The physiological manifestations in characteristic form for a given individual frequently tell a story by themselves. Thus, nausea may be the expression of dissatisfaction or disgust; diarrhea, of insecurity or worry; colitis and migraine, of anger; tachycardia and palpitation, of fear; and constipation, of restraint, resistance, and stubbornness. These physiological responses frequently make themselves more important than their psychological content, and so justify the patient in his illness. Unfortunately, if these mechanisms are not fully understood, they may be mishandled, and the symptom complex becomes more firmly fixed in the individual's mind.

CARDIAC SYMPTOMS

Much harm can be done when a physician in the absence of sufficient evidence, unthinkingly tells the patient he has heart disease. Every physician knows that he cannot be certain whether or not the heart is structurally damaged, and, in the absence of such knowledge, it is natural for him to be cautious. But by being cautious he sometimes causes the patient to become overly apprehensive. If he warns a man never to run for a train or run upstairs, never to walk into a strong wind, or never to lose his temper, he may create such damage to the patient's psychological mechanism that the individual becomes an invalid. Although pain and breathlessness are cardinal symptoms of heart damage, they are also present in the so-called cardiac neuroses.

An accurate assessment of symptoms is the best means of differentiating between structural damage and cardiac disorders due to emotional disturbances (*5*). Such a differentiation is essential to intelligent handling of the heart patient. On the other hand, it is necessary to remember that the patient with structural damage to the heart also is often anxious and emotionally disturbed, and many of his complaints may be the result of this disturbance, rather than of his heart lesion.

When children suffer from rheumatic heart disease, they usually also have emotional problems, and these are frequently precipitated by the parents. The bugaboo of rheumatic fever is the ever-present danger of recurring attacks with further damage to the heart. It is difficult to instruct a mother to be on the lookout for vague symptoms of reinfection, which are the common ones in childhood, without arousing undue anxiety in her, and eventually in the child. If we do

arouse too much anxiety, then the mother will overprotect her child, worry over him, fuss over him, keep him in bed long hours, urge him to eat, and be alarmed at the slightest headache or evidence of fatigue. On the other hand, an overanxious mother may, because of her fear, also be blind to obvious signs of trouble and assume a casual attitude, which may be even more damaging than the oversolicitous one.

If the child is so recovered from his illness that he can regain a place in the world no matter how handicapped he may be, he must be taught the two most difficult lessons of childhood—if not of life. One is to defer an immediate satisfaction for an ultimate gain. The other is to accept certain inexorable limitations of his capacity. He will learn these lessons best if he is not overburdened with anxiety.

In the individuals who suffer from so-called cardiac neurosis, anxiety is of cardinal importance. These individuals report unpleasant, often frightening sensations, which they attribute to their heart. They complain of such symptoms as tachycardia, palpitations, and sometimes even extrasystoles.

We know that outbursts of rage, or startle reactions, as from fright or the hearing of bad news, are sometimes followed by sudden cardiac failure. Every cardiologist is aware of the effects of anxiety or emotional tension on the coronary circulation. We have all noticed the sudden rise of blood pressure when putting on the manometer cuff.

ENDOCRINE SYSTEM

For many years it has been known that the emotions affect the endocrine system, whether it is the adrenal glands, the pancreas, or the thyroid. Even the surgeon has to admit that hyperthyroidism is not a disease entity but a group of symptom-complexes with a fairly definite course, evolving from autonomic imbalance and characterized by the signs of fear and anxiety, such as tachycardia, tremor, and a heightened basal metabolic rate. The organic changes such as enlargement of the thyroid gland and various degrees of exophthalmos do not come until late in the disease, but early in the course the person takes on the appearance of being chronically frightened.

It is an accepted fact that there is a close relationship between the thyroid and the sex glands, and it is interesting to note that exophthalmic goiter is more common in women than in men. Perhaps the sex history will give an indication of the cause. Certainly, in every case of exophthalmic goiter the family history will indicate an unstable background, and the onset of the symptom complex will be dated to a period of worry or mental shock. Whether the practitioner is a surgeon or an internist, no one now seriously doubts the fact that the inherent constitution of the patient is a determining factor; and yet there are still those who insist that exophthalmic goiter is a

surgical problem, and the cure is by extirpating this constitutional psychopathology.

There may be very severe symptoms associated with no evident thyroid enlargement, while on the other hand, the symptoms may be practically absent although there is glandular enlargement. The removal of a large part of the thyroid gland in a chronic and well-established case of exophthalmic goiter may result in a noticeable subsidence of the symptoms while in other cases the operation seems to have no effect. Thyroidectomy necessarily removes the patient from her home and thus may interrupt the vicious circle in which the patient lives. This may be all that is necessary to bring about a temporary symptomatic cure, but on the other hand it does not get rid of the primary cause of the trouble. The symptom complex, including the exophthalmos and rapid heart, may be simply a secondary result of an aggravating environment. In other words, the involuntary nervous system may be stimulated from without and not from within. Thus it is obviously necessary to consider not only the individual, but also his environment, for it is impossible to explain the symptoms of exophthalmic goiter from any common cause.

One thing is certain, the victim of exophthalmic goiter is a highly sensitive, irritable, or "touchy" individual, who responds to life with extreme delicacy. As a consequence he has an emotional life varying from ecstasy to profound depression. The individual is often manic and thrives on stimulation, and belongs essentially to the artistic type. Analysis of the history usually reveals that the psychopathology was already present long before the organic symptoms of the disease became manifest. The sensitive emotional personality explains why this syndrome is more common in women and why young children whose emotions are not fully developed are comparatively free from the disease.

If the physician has been able to follow the patient over any length of time before the onset of the symptoms and has witnessed the transition, he has, no doubt, been impressed with the fact that he has been witnessing nothing more or less than an exaggeration of a normal trend; for the emotional instability becomes greater, the manic tendencies more noticeable, the pulse more rapid, and the tremor more pronounced. In other words, the personality becomes hypertrophied. Even the organic evidences of the disease become exaggerated; the thyroid gland swells—or if it has been previously swollen it grows larger. The wide staring eyes become more prominent, and the basal metabolic rate becomes elevated.

The underlying personality is evidently a result of excessive protection by the parents, for the individual has been so shielded from possible harmful influences that when he reaches adult life he is

unable to cope with its ordinary tribulations. He claims that his life is an unusually hard one. In other words, he remains infantile in his reaction to his environment. He becomes morbid, introverted, and exceedingly interested in the interpretations of his own psyche. He shows a tendency to love the mystical, and continually rationalizes his motives.

Hyperthyroid patients show many disturbances of the sexual life. Frigidity in women is almost universal. There is fear of pregnancy and fear of childbirth combined with intense resentment and repressed aggression against men. The unmarried girls reveal psychosexual infantilism. In men, similar situations exist; degrees of sexual impotence or, at least, difficulties in sexual adjustment are always present.

All available evidence shows that the thyroid gland is not the primary organ affected, but that it is a link in the chain of circumstances between the so-called personality or constitution, on the one hand, and the expression of exophthalmic goiter on the other hand. Whether the mechanism is through the autonomic nervous system, or through the action of the endocrine organs, especially the thyroid and adrenal, is an unsettled problem but, in any case, it is an obvious fear reaction.

Every physician is aware of the functional changes that take place during fright, such as a rise in blood pressure, elevation of the basal metabolism, rapid pulse, pounding heart, increase in blood sugar, decrease in ascorbic acid excretion, cold sweat, gastrointestinal changes, and spasms of the stomach, colon, urinary bladder, and bronchi. Such functional disorders are as a rule evanescent, and cease when the insult has spent its force, but if the emotional insults continue over prolonged periods the functional reactions become more or less fixed, and the functional reaction becomes conditioned. The blood pressure, the basal metabolism, and the pulse rate remain elevated and the endocrine system must necessarily hypertrophy to keep up to the demand.

Our present knowledge of diabetes mellitus is such that we have not been able to bridge the gap between the growing volume of literature on personality and neurotic manifestations, on the one hand, and important physiological discoveries, on the other. Nevertheless, there are many cases which indicate the sudden appearance of diabetes associated with emotional stress. It has been definitely established that emotions do play a role in the fluctuation of the sugar level in cases of diabetes.

Obesity is very closely tied up with diabetes, and there is no doubt that obesity of all types indicates a disturbance in the caloric balance. More food calories are taken in than are utilized in the production

of energy. In the study of obese patients it is very evident that a number of motives for excess eating, beyond that of appetite is evident. The most common motive is an inner feeling of emotional emptiness, a boundless void which eating will temporarily, but never completely, alleviate. Overeating may be a physiological attempt to compensate for lack of love and security in the early years, and is more a craving than an appetite. This compensatory drive may also become confused with the reproductive instinct through the childhood fantasies of oral eroticism.

ACHES AND PAINS

The patient who complains of aches and pains in the muscles and joints is frequently seen in general practice. He may also complain of chronic fatigue and a slight fever. These cases may be diagnosed as tuberculosis, rheumatism, and, recently, chronic brucellosis has become a frequent diagnosis. Usually these patients are treated by rest and more rest, and continued restriction of their life activity.

An investigation of the history of these patients will usually bring out the fact that they are poor sleepers, their sleep is disturbed by dreams, they have marital problems, and they have made a poor sexual adjustment. Significant emotional conflicts may be found which are apparently responsible for the fatigue. But the special feature associated with muscular aches and pains is the presence of chronic resentment, of which the patient is usually totally unaware. The muscles serve as a means of defense and attack in the struggle for existence, and thus the internal tension is most easily relieved by muscular action. When the external expression of aggression in the form of muscular action is inhibited, then muscular tension may result, which is felt by the individual as pain and limitation of movement. This often is interpreted by the physician as a fibrositis, or muscular rheumatism.

In chronic orthopedic conditions the question will always arise as to why the patient came at just that particular time to the physician. It will frequently be found that the patient's threshold of discomfort has been lowered by some alteration in the working conditions or by a shift in the family relations, setting up an altered emotional state. Understanding the problem and fitting the circumstances to the individual often make surgery unnecessary. Sometimes a patient makes a regression to infantile states, or there may be unwillingness to recover, because of the advantages of a secondary gain. Also, there may be an unconscious wish for punishment. These individuals are frequently accident-prone.

GASTROINTESTINAL TRACT

The vascular supply to the mucous membranes of the gastrointestinal tract is definitely altered by the emotional state. Rage is accompanied by an engorgement of the lining of the stomach, and sudden fear by blanching. Analogous changes occur in the nose, the bowel, the bladder, and the vagina. Everyone is aware of the effect of emotions on the blood supply to the penis. Under emotional stress the temperature in the fingers and toes may drop as much as 35° F. The reduction in the renal blood flow may be as much as 40 percent under such conditions.

The emotional elements in peptic ulcer are well known. Every ulcer patient has noted recurrence of ulcer activity with the appearance of tension. The peptic ulcer conflict develops from an unconscious longing for a dependent relationship and a reactive striving for asserting independence. Again, in these patients, the conflict begins in early childhood. The child seeks security by striving to meet rigid exacting standards set up by the early authoritative figure, such as the parent or teacher, while at the same time anticipating failure because of a strong feeling of inadequacy. To allay this fear of failing or losing security the child struggles to perform precisely in the manner he feels is expected of him.

As the person grows up, he continues to utilize the same pattern in seeking security, but new circumstances in his life engender further conflicts. At adolescence strong investigative and creative urges emerge, which he feels have to be suppressed. Unconsciously he still harbors a compelling fear that his security is threatened if he pursues any but the goals that have been set for him. This is the source of conflict. Resentment inevitably accompanies the need to deny and reject his own inclinations and fancies. In addition, the demands of society, representing security to him, appear to become more elusive and unobtainable than they were in childhood. Thus, tension develops in his pursuit of security. The striking feature of the ulcer patient when he is caught up in such a conflict is that he either physically tries to do what he feels is impossible or mentally wrestles with countless possibilities in an endeavor to discover the proper solution. The ulcer patient never gives up trying to accomplish his set task. Frequently he continues until his ulcer symptoms remove him from the conflict situation.

The emotions of resentment, anger, and anxiety are found to be associated with hypersecretion of acid and pepsin, hypermotility, hyperemia, and increased mucin elaboration; fear and resentment may cause a definite decrease in the secretion of mucin. Other evidences of autonomic nervous system imbalance, such as excessive palmar sweating, tachycardia, bradycardia, urinary frequency, spastic colitis, and

mucous colitis, are very frequently present in cases of peptic ulcer and may persist even after the disappearance of the epigastric distress.

It is not the autonomic nervous system disturbance alone, but the particular imbalance which occurs with ulcer conflict situation that appears to favor the development of ulceration. In normal people such a conflict situation may result in appearance of transient heartburn or epigastric distress which is relieved by milk and alkalines. But in ulcer patients the character structure is such that this conflict becomes sufficiently lasting and intense for him to develop actual ulceration.

Finding the character traits typical of the peptic ulcer patient aids in making the diagnosis of peptic ulcer. Such traits include being overly conscientious, meticulous, careful, and hard-working. These patients anticipate difficulty far in advance and rely heavily on plans to achieve their goals, all the while fearing and anticipating failure. They react badly to change, feeling inadequate to meeting the new environments as they construe them, no matter how many successes were theirs in the past. They do not allow themselves the right to make an error, and they function in many seemingly unimportant jobs as though their very existence were at stake. Such tension is made the greater and more obvious when they work under supervisors whom they consider strict and stern.

Every person has experienced the effect that sudden fear has on the colon. It is an effective drugless remedy for constipation. Everyone is aware of the potent effect of excitement on the gastrointestinal tracts of children. Because these effects are usually transient, it is not always realized that they may be prolonged if the emotional state is prolonged.

The effect of normal reflexes such as the urge to defecate and the gastrocolic reflex are qualitatively similar to the effects induced by emotional states. However, the reflex action is transient and sustained only long enough to accomplish the required physiologic result. The effects of the emotional state, however, may be prolonged or recurrent if the environmental situation which generates it persists. This might well happen often enough to keep the colon in an almost constant state of hyperactivity, particularly if the patient has a tendency to brood over his troubles.

Biochemical studies have revealed an interesting relationship between the presence of increased amounts of lysozyme to hyperactive states in the colon. This enzyme has been found in larger amounts during periods of increased activity resulting from emotional stress. The lysozyme content of the stool was also found to be greatly increased in patients with ulcerative colitis during exacerbations of the disease. Application of the enzyme to exposed colonic mucosa caused

hyperemia and even beginning ulceration. Possibly this enzyme may play a somewhat similar role in the production of colitis to that played by hydrochloric acid and pepsin in the etiology of gastritis and peptic ulcer. Its production is increased during the state of hyperactivity and its chemical action tends to erode the mucous membrane. Emotional states are important factors in colonic dysfunction and are of major etiologic significance in chronic ulcerative colitis.

HEADACHE

Most general practitioners see patients with severe headache, which may be diagnosed as migraine. There is no doubt that this problem is psychosomatic, and that a knowledge of the migrainous temperament aids in the diagnosis and treatment. The typical migrainous patient is short of stature, with a trim, well-proportioned body, better than average looks, has bright and expressive eyes, and a quick reaction time. This person is generally hypersensitive to lights, sounds, and smells. He is tense, reacts intensively, tends to worry, tires easily and often suddenly, and sleeps poorly. He is usually of above average intelligence and willing to assume responsibilities whenever offered. Dissatisfaction in marriage is often encountered, and attacks of migraine depend largely on the amount of strain under which the patient lives.

In the southeastern part of the country there seems to be a prevalence of sinus conditions and patients may undergo endless treatments to relieve the congestion without locating the etiologic agent. Impulses traveling by way of the vagus may cause congestion of the nasal mucosa, and originally such a mechanism may have been desirable to exclude noxious vapors from the nose. If, however, the stimuli are prolonged they may give rise to impairment of drainage of the nasal sinuses and interfere with normal breathing. Reactions in the upper respiratory tract are produced by excessive parasympathetic stimulation secondary to emotional situations. Fear and sadness evoke a vasoconstrictor response, with shrunken turbinates, pallid mucosa, and hyposecretion. During episodes of conflict with frustration and resentment, the nasal mucosa first becomes hyperemic, then the turbinates and the mucous membranes become swollen and secretion is increased and, finally, occlusion severe enough to interfere with breathing may occur. When the emotional conflicts are sustained the reactions are more intense and tend to become bilateral. When this condition continues, pain and tenderness develop and extend over the malar and temporal regions. These reactions have definite pathologic implications. Under these circumstances the function of the cilia is interfered with, and the swollen mucous membranes obstruct drainage

from the sinuses, and so render the tissues more vulnerable to bacterial invasion.

ALLERGY

Today we hear a great deal about allergy, and, with the new preparations which are given to desensitize the person, more emphasis than ever is being placed on this common complaint. Asthma, hay fever, eczema, and hives may have a very definite psychosomatic basis. The personality of the asthmatic and, even more important, of his parents, plays an important role in the development of the symptoms. The parent is found to be domineering, often in a gentle way, and often overly protective. The asthmatic himself is aggressive, nervous, demanding, and there is a constant conflict between his self-expression and aggressive tendencies and the necessity to suppress them in order to secure love and avoid rejection. The allergic person is usually very suggestable and his symptoms may be more likely precipitated by what he hears or sees, rather than by what chemically affects him. Allergists uniformly agree that psychic factors can bring about changes in the threshold of sensitivity to allergens.

SEXUAL DYSFUNCTION

Sexual maladjustment is commonly seen in general practice and more unhappiness in marriage is due to this than perhaps any other cause. Most certainly many neurotic symptoms are brought to the surface by this cause. Frigidity, impotency, or lack of libido, are all symptoms of emotional conflict. It may be fear or it may be disgust. Perhaps it is conflict or guilt over masturbation, it may be a homosexual panic, or perhaps it is an Oedipus complex, or a fear of castration. The type of sexual behavior is certainly not inherited, it is acquired and comes as a result of conditioning. Injections of hormones will not correct the difficulty; they may even aggravate the symptoms.

CONCLUSIONS

As stated at the beginning of this article, no physician today can afford to limit his attentions only to the somatic side of disease, as no illness can be thought of as being entirely psychological or entirely organic. Unfortunately, there is a tendency for physicians to feel that if the right chemical formula can be found, the pathologic changes in the person will thereby be corrected; and surgeons are apt to feel that, if a pathologic lesion can be diagnosed its removal will correct the symptoms. If they cannot discover organic pathologic changes, they may dismiss the patient with the statement that

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the complaint is imaginary, or to give some placebo. In common parlance, they may "kid the patient along," rather than search for a deeper etiologic reason. If the physician would take the time to investigate the social and psychological factors in the person's psychopathology, many serious disturbances might thus be prevented.

The family physician in the past was the confidant of his patients, and, undoubtedly, by the process of mental catharsis helped his patients through difficult times. Today the general practitioner may not be willing to spend the necessary time to relieve the patient's tensions and, consequently, the individual is driven back into himself.

Although the medical profession and the general public are today more aware of psychological etiology, the stresses of life appear also to be increasing, and something definitely needs to be done to help people to a more stable existence. Most certainly, the general practitioner can do a great deal to help patients to gain this necessary insight. If they find themselves unable to do so, the earlier psychiatric assistance is obtained, the more easily the underlying psychopathology is corrected.

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Prophylactic Odontotomy

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SINCE the etiology of dental caries is still obscure, any dental procedure which would reduce the number of teeth that have to to be extracted because of the effects of caries, would be a step forward. Prophylactic odontotomy consists of the removal by cutting of a defective part of a tooth in order that the area so treated may be protected from a threatened onset of caries, the operation being confined to those morphologic imperfections called pits and fissures (*1*). The name prophylactic odontotomy was originated by Quinby (*2*). Following a paper by Hyatt in 1922, there was a great deal of interest in prophylactic odontotomy. In a short time, 19 State dental societies, the American Dental Association, the Canadian Dental Association, the Oral Commission of the Federation Dentaire Internationale, and 13 other dental organizations officially endorsed the idea that particular care and attention should be given to developmental pits and fissures, whether occurring in primary or secondary teeth, and whether decay was present or not (*3*). However, additional research did not support this enthusiastic attitude. A more rational and conservative feeling predominates today. There is some evidence that the filling of early cavities or even caries-free susceptible fissures, reduces the number of teeth that have to be extracted, but as yet there is no statistical study that demonstrates accurately the value of such procedures, as compared with other forms of dental care in preventing dental decay (*4*).

Relationship of developmental defects to caries.—Some specific areas of certain teeth are highly susceptible to decay (*5*). These areas occur in the imperfections in enamel when perfect fusion of embryonal enamel lobes does not take place (*1*) (*6*) (*7*). If we consider the developmental lines evidenced on the occlusal surface of the molar teeth as one ramifying developmental line, the entire adult dentition would have 164 (*6*). Clinically, a fissure is distinguished from a normal groove by examination with a sharp explorer, after having isolated and dried the tooth. In a pit or fissure, the tip of the sharp explorer will sink below the surface at the point of entrance and cling between the narrow walls of the pit (*8*). However, the

explorer is not a reliable instrument in determining where caries is present or may develop (*8*) (*9*). Bödecker (*10*) examined ground sections of molars and found that the occurrence of occlusal fissures or faults was so common that he regarded them as normal. They existed in prehistoric men and are also present in the teeth of both primitive and civilized races today. By using the photomicrograph, pits or fissures that are too narrow to be entered or caught by an 18-micron explorer, may be demonstrated.

In attempting to correlate developmental defects with caries, Bödecker (*10*) (*11*) pointed out that a protecting cap or film of unremoved food debris forms bacterial plaques that can be harbored by a pit or fissure. A pit or fissure may harbor 8.4 billion bacteria (*10*). Fisher (*12*) used a special stain to demonstrate these sheltered positions. Food debris is usually composed of a high percentage of carbohydrates. The lactic acid produced by the fermentation of the carbohydrates attacks the enamel and initiates the dental decay. There is little opportunity for saliva to enter through the small opening and dilute the acid produced. The incomplete protection afforded to the dentin by the enamel enhances the progress of dental decay. Assuming that a positive relationship exists between developmental defects and caries, we should expect to find a high susceptibility to caries in areas where the greatest number of developmental defects occur, namely, the occlusal surface of the molars and bicuspids, the lingual surface of the upper molars and upper lateral incisors, and the buccal surface of the lower molars (*5*) (*6*) (*13*) (*14*). This contention has been substantiated (*15*). Occlusal cavities occur (*a*) 24 times as often as lingual cavities; (*b*) 10 times as often as buccal cavities; (*c*) 6 times as often as distal cavities; (*d*) 5 times as often as mesial cavities; and (*e*) 2 times as often as the number of all cavities in all other surfaces combined.

An investigation of 12,753 persons, ranging from 16 to 60 years of age in diversified occupations revealed that (*a*) 52.44 percent of all carious cavities were on the occlusal surface of bicuspids and molars; (*b*) 5.9 percent were on the buccal surface of lower molars; (*c*) 4.44 percent were on the lingual surface of the upper molars and lingual surface of the upper lateral incisors; and (*d*) the remaining 37.22 percent were distributed over the remaining surfaces of other teeth (*1*). This report substantiated Hyatt's original findings and clearly demonstrated that those areas where we find the greatest number of developmental defects have the greatest susceptibility to caries.

Prophylactic odontotomy techniques.—Prophylactic odontotomy attempts to prevent the inception of dental decay in these precarious areas by restoring their surface to a cleansible continuity (*5*). Since microscopic examination of specimens establishes the fact that decay

begins in the fissures soon after the eruption of the teeth, it is imperative to treat these areas as soon as possible after the teeth erupt (*16*). When the entire occlusal surface of a molar or bicuspid has erupted, it is cleansed with warm water and then with hydrogen peroxide. Cavity varnish is applied after the surface has been dried. The varnish is scratched through along the groove with a sharp-pointed explorer. Howe's silver nitrate[1] is applied and then reduced with eugenol (*17*). The whole surface is then polished with a rubber cup and pumice to remove the stain. A fine black line will be seen where the silver nitrate has penetrated through the varnish into the tooth. In this way conservation of tooth structure can be accomplished. When the tooth has erupted sufficiently to permit the use of a rubber dam, a class I cavity is prepared and a restoration is placed.

Bödecker (*16*) advocates an operative immunization technique for the eradication of pits and fissures. By using a new No. ½ round bur and then progressively larger burs, the shape of the pit or fissure is changed to that of a shallow self-cleansing groove. The groove is then polished. However, if the pit or fissure penetrates through or nearly through the enamel, enlarging is stopped and the defect corrected by the placement of a permanent restoration. In only a few instances is the immunizing operation applicable, therefore a permanent restoration is indicated in about 95 percent of the cases (*18*). Risser advocates a therapeutic immunizing technique for very young or nervous children where operative interference is not considered advisable. Howe's silver nitrate is deposited in the pit or fissure until operative measures can be taken. Amalgam is the material of choice in filling deciduous teeth, although tinfoil and copper cement may be used (*1*) (*7*). Tinfoil is easy to manipulate and can be placed rapidly, since no malleting is needed. Tinfoil or cement should be used during the eruptive period of permanent teeth. For 3 or 4 years after eruption of the tooth, gold is the material of choice. Amalgam may also be used, but not copper cement (*7*).

Advantages.—There is still some controversy regarding the advantages of prophylactic odontotomy. Advocates of this procedure emphasize the fact that the procedure (*a*) is simple (*2*) (*5*); (*b*) saves time and expense to the patient (*7*) (*19*) (*20*); (*c*) insures better cooperation of the patient, since most of the excavation is done in the enamel and is, therefore, painless (*5*) (*21*); (*d*) favors the dentist economically since children constitute the best foundation for building a practice (*5*) (*20*); (*e*) places emphasis on early dental care since it is especially applicable to children (*1*) (*7*) (*20*); (*f*) stimulates careful and conscientious examination (*19*) (*22*); (*g*)

[1] Three gm. of silver nitrate, 1 cc. of distilled water, and 2.5 cc. of 28 percent ammonia.

enables most tooth structure to be saved by preventing widespread tooth decay (*5*) (*19*) (*20*) (*22*); (*h*) reduces to a minimum the amount of pulp irritation since the fillings are very small (*5*); and (*i*) renders teeth so filled immune to caries in the area so treated (*3*) (*5*) (*7*) (*20*). McCall (*9*), Waas (*23*), Rhein (*24*), and Kells (*25*) dispute these claims.

Studies in the prognosis of caries.—Since so much dispute exists relative to the merits of prophylactic odontotomy, many dentists hesitate to interfere surgically in what appears to be good tooth structure. As yet it has not been demonstrated that the teeth can tolerate surgical intervention in the absence of actual disease (*8*). The modern approach to this problem should be a search for more accurate criteria for the prognosis of caries before advocating prophylactic odontotomy. In the search for a sounder basis for surgical interference, Bossert (*26*) attempted to determine the relation between the shape of the occlusal surfaces of molars and the prevalence of decay. He examined the upper right first permanent molars of 100 patients whose ages ranged from 7 to 25 years. Models were made of the teeth examined. The ratio of the depth to the breadth of the mesio-occlusal valley was recorded. The ratio ranged from 1:0.17 to 1:0.74. The ratio was compared with the frequency of occurrence of caries. It was found that the steeper the sides of the valley, the greater the probability of caries in the central pit.

Four years later, Bossert (*27*) made similar studies using the second deciduous upper right molars of 300 children in New York whose ages ranged from 2 to 8 years. If the slopes of all deciduous teeth were reduced before decay, the probability of caries was found to be reduced from 83 to 72 percent. Scott (*28*), in his study of the bilateral incidence of carious lesions, pointed out the large production of destructive lesions in identical surfaces of corresponding teeth situated on the opposite side of the mouth. This knowledge, that a tendency to a bilateral occurrence of carious lesions exists, is an important factor in determining which teeth are, or will become, carious.

Hyatt (*29*) correlated certain anatomic variations in tooth structure with dental caries. The difference between the number of carious areas in the upper and lower second bicuspids was not large and was similar to that observed in the upper first bicuspids. However, lower first bicuspids had a lesser number of carious areas. The buccal and lingual cusps of the upper and lower second bicuspids and those of the upper first bicuspids were much the same in size and shape. The buccal cusp of the lower first bicuspids was almost the same size and shape as that of the other bicuspids. The lingual cusp of the lower first bicuspid, on the other hand, was small and afforded an easier

migration of foods from its surface. The number of cavities in lower first molars was much higher than that of upper first molars. The location of the mesiobuccal cusp of the upper first molar caused it to close over the buccal pit of the lower first molar and forced food and free mouth acid into the pit.

Brucker (*8*) claimed that there was no clinical proof of the contention that (*a*) 99 percent of fissures decay (Hyatt); (*b*) 95 percent of the teeth are defective on eruption (Bödecker); and (*c*) 98 percent of all first permanent molars become carious (Bödecker). Fissures that have not been invaded by caries in the first 5 years of tooth life rarely decay, even when defectively developed (*30*). Over a period of 21 years, clinical studies and observations, supplemented by follow-up investigations, prove that it is erroneous to assume that all cavities on the occlusal surfaces of premolars and molars have developed from preexisting fissures, even when these fissures were defective (*8*). Brucker based this conclusion on observations of over 2 million occlusal surfaces in 200,000 pupils. Although Waas (*23*) states that an accurate test for susceptibility to caries is not available, Easlick (*31*), believes that such a test exists, as a result of the work of Hadley and Jay in 1933, and of Fosdick, Hansen, and Epple in 1937, relative to a method of determining immunity to caries.

The work of Hyatt and his associates was performed chiefly in the Northeastern part of the United States (*32*). No adequate consideration has been given the geographic caries pattern or the influence of ethnic background on the prognosis of dental caries. A statistical survey of defective and missing teeth in 22,117 soldiers showed that dental caries follows a definite geographic pattern in the United States (*33*). Caries is most severe in the Northeast, moderate in the Western sections, and least severe in the Southwest. This pattern has existed for the past 80 years with little or no change. A study of dental defects of selectees at the Boston Armed Forces Induction District in relation to the nationality and socioeconomic background of the members of communities from which these selectees came, indicated that the incidence of caries per person was highest in the wealthiest communities and lowest in the poorest (*34*). The total amount of caries was over 15.5 per person in the English, Irish, and Canadians; 10.5 in the Portuguese and Russian Jews; 9.5 in the Negroes; and 6.8 in the Chinese. The mid-Europeans and Italians were in the middle group. This wide difference in dental decay in different nationalities is important because it shows the insignificant place of dental care in the prevalence of dental decay. The teeth of aborigines are almost perfect while on their native diet, but become carious when they change to a civilized diet (*34*). This suggests that the element of racial susceptibility is entirely secondary

to dietary habits, although further studies may be required to prove this. Fisher (*12*), in an attempt to correlate prognosis for dental caries with the type of contact between the teeth, concluded that susceptibility to caries was greatest in the rectangular type and least in the round type. Prognosis for caries may also be correlated with lack of contact points, since teeth that have large spaces between them have a low susceptibility to caries (*35*). This is demonstrated when spaces between teeth are created by extraction.

SUMMARY

Hyatt's work has stimulated great interest in prophylactic odontotomy. Some areas of certain teeth are highly susceptible to decay. These areas are believed to be developmentally defective. Attempts have been made to prevent the inception of dental decay in these areas by restoring their surface to a cleansible continuity. There is some evidence that the filling of early cavities or caries-free susceptible fissures reduces the number of teeth that have to be extracted, but, as yet, there is no statistical study that proves the value of such procedures, as compared with other forms of dental care. Controversy still rages around the claims made for prophylactic odontotomy. Further studies in the prognosis of caries are needed before prophylactic odontotomy can be practiced on a sound scientific basis. The findings relative to prophylactic odontotomy that have been reported should be either substantiated or corrected. Statistical studies have suggested a relationship between the prevalence of decay and (*a*) the shape of the occlusal surface; (*b*) certain anatomic variations of tooth structure; (*c*) ethnic background, geographic pattern, and socioeconomic factors; (*d*) tests for susceptibility to caries; and (*e*) contact points. A tendency toward bilateral occurrence of caries has also been suggested. Fissures that are caries-free during the first 5 years of tooth life rarely decay.

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Advantages of Air Transportation of Patients

WILFORD F. HALL, *Colonel, U. S. A. F. (MC)*[1]
JOSEPH D. NOLAN, *Captain, U. S. A. F. R. (MSC)*[2]

AIR transportation of patients is a realistic approach toward implementing the objectives of reorganization of the Federal medical activities, as recommended by the Hoover Commission. These objectives are: to provide better medical care for the beneficiaries of the Federal Medical Program; to create a better foundation for training medical personnel and improving medical service in the service agencies; to reduce the drain of doctors from private practice; to provide better organization for medical research; and to promote a better state of medical preparedness for war.

Before examining in detail the effect that air transportation of patients by the Military Air Transport Service [3] will have toward implementing those objectives, it would be well to answer the pertinent question, "How will air transportation of patients affect the existing situation since it has already been in use for some time?"

The use of aircraft for transportation of patients is almost as old as the airplane itself. During World War I aircraft were used to a very minor extent for the evacuation of casualties. In the period between World War I and World War II air transportation of patients was confined to paper proposals (except for use by the French in the Riffian War).

World War II brought about the first large-scale use of aircraft for the transportation of patients. The methodical Germans tried it out in Spain, along with their trial of other military measures, in their dress rehearsal for World War II. The tremendous growth of air transportation of patients during World War II is evidenced by the following figures which represent the total number of patients transported each year: 1943, 173,527; 1944, 545,004; 1945, 624,128; 1946,

[1] The Air Surgeon, Military Air Transport Service.
[2] Medical Air Evacuation Division, Military Air Transport Service.
[3] MATS has the responsibility for patient transport over world-wide established air routes except over routes of sole interest to the Navy which cannot be served by MATS.

13,959; 1947, 18,000; and 1948, 18,078. Upon cessation of hostilities, the number of patients carried dropped sharply from 1946 through 1948, but these figures represent an appreciable percentage of the total number of patients transported.

During World War II, air transportation of patients was supplemental to the primary means of patient evacuation; i. e., hospital trains, hospital ships, and ambulances. The aircraft utilized for evacuation of patients were, for the most part, cargo or troop carriers and were used for return of patients to hospitals largely on a "hit or miss" basis. This means that those responsible for transportation of patients in combat areas relied on means other than aircraft for evacuation of patients and used aircraft as a bonus measure. After the war, the use of all methods of transportation of patients was continued, until the pressure of necessity caused by critical shortages of Medical Department personnel plus the perfection of the air transport system, made necessary a restudy of the methods of patient evacuation. This study revealed some very interesting statistics. For example, it showed that 21 times more medical personnel are required for transportation of patients on surface vessels than for the same number transported by air.[4] Only in rare cases where a patient's condition indicates the need are the services of a medical officer required. Trips via air transport aircraft have great advantages in speed, flexibility, and frequency. MATS C–54 air evacuation aircraft travel, approximately 10 times faster than a hospital ship, require only 34 patients instead of 300 to make up a full load, and may be directed in any direction over land or water. Trip frequency is greatly increased, eliminating the need for large holding facilities and long delays in getting patients to definitive treatment centers.

Although air transportation of patients has been in use for a long time it has never been used as a *primary* means of patient transportation. Thus, full utilization has not been attempted. Full utilization is the answer to the question of how air transportation of patients will implement the objectives recommended by the Hoover Commission. Our medical services program can then be planned on the basis of all patients being moved by air; patients with serious ailments will then arrive immeasurably quicker at medical installations best equipped and best staffed to undertake treatment. The ability to move patients rapidly, comfortably, and safely from all points of the world to highly qualified specialists concentrated in relatively few medical centers, will make their services available to the greatest number.

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[4] From Joint Chiefs of Staff dated 17 June 1949, "Report by Joint Logistics Plans Committee."

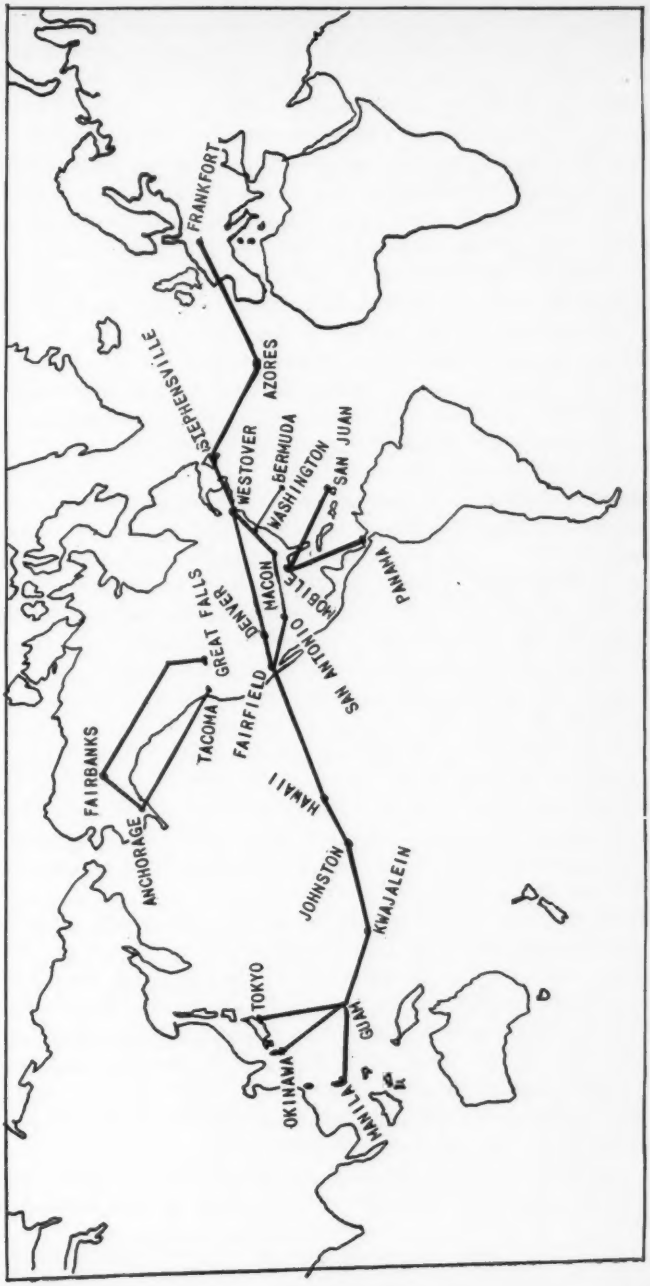

Figure 1.—Scheduled routes of the patient flights of the Military Air Transport Service.

The medical training program at present is partially "farmed out" to civilian institutions where hundreds of our medical officers are in resident training. These programs provide excellent training but completely lose the badly needed help these trainees would be rendering to the Federal Medical Program were they in training in our military institutions. Concentrations of most of our best specialists in Federal medical institutions (regardless of the geographical deployment of our troops throughout the world) plus the adoption of the system to bring into these designated teaching institutions world-wide clinical material, will certainly help our training program—it will also pay an extra dividend in helping us cover our medical officer personnel requirements for the care of the sick.

Reducing the drain of physicians from civilian life means that the military services must operate with the smallest possible percentage of medical officers per thousand personnel. These requirements are greatly increased when military personnel are stationed in small numbers in far distant and widely separated areas. Air transportation will eliminate much of the necessity for having large numbers of medical officers stationed in distant areas since serious and special cases may then be moved quickly to highly specialized medical centers regardless of distance. Then obviously, medical research will be stimulated and promoted, since both clinical material and qualified personnel will then be available at these medical installations.

With air transportation of patients as a primary means in time of peace and war, our state of medical preparedness for war will be closely allied with our state of air preparedness.

The transportation of patients by air as a primary means may be said to have actually begun on 28 September 1949, with the laying up of the hospital ship, U. S. A. T. *Comfort*, from trans-Atlantic service. It is anticipated that on or about 1 January 1950, all surface means of patient transportation including hospital ships and hospital trains will have been removed from the service.

Within the continental United States, the main routes of patient transport are predicated upon the location of various Army and Navy hospitals. This main route appears in figure 1 as the U-shaped loop, running from the East Coast through the South and Southwest, to the West Coast and return. Direct East-West and West-East transportation is by transcontinental flights. Other patients originating either overseas or in the Zone of the Interior are moved along the U-shaped route on 3 flights a week. Comprehensive feeder operations supplement these main line flights.

This is only the beginning. It is anticipated that use of air transportation for patients will show an increasing upward trend in the future.

Immunizations for Foreign Travel

WILFORD F. HALL, *Colonel, U. S. A. F. (MC)*[1]

THE Military Air Transport Service has recently issued a sixth edition of its "Guide to World-Wide Immunization Requirements." The first edition of the series was issued on 10 May 1948. It was conceived and developed to meet a constant need throughout this global command for up-to-date world-wide immunization information in connection with actual processing of both military and civilian passengers bound for world-wide destinations on MATS aircraft.

The MATS Immunization Guide has met enthusiastic acceptance, not only in the Armed Forces all over the world, but also by such nonmilitary organizations as the Civil Aeronautics Administration, the American Automobile Association, and the Standard Oil Company of New Jersey. It is believed to be the only complete, up-to-date publication of its kind. The information contained therein is completely documented.

The Guide makes no attempt to prescribe immunization requirements but simply sets forth in a clear and concise manner what the requirements are as prescribed by the Army, Navy, Air Force, and about 200 foreign countries. It also gives the immunization recommendations of the U. S. State Department and the U. S. Public Health Service. Thus the document is fully applicable to the processing of civilians as well as military personnel for travel abroad following any predetermined itinerary.

A new feature of the sixth edition is a table of both adult and child dosages. Detailed information is also given in reference to initial series and stimulating dosages.

During the recent war the Armed Forces immunization records (Army and Air Force, WD AGO Form 8–117; Navy, Navmed 585) were accepted as valid evidence of immunization almost anywhere in the world. Since the war many foreign governments, reacting to the stimulus supplied by the World Health Organization, are demanding the international model certificate of inoculation and vaccination as part of their quarantine clearance procedures. The already extensive

[1] The Air Surgeon, Military Air Transport Service.

list of such countries continues to grow. Information as to which countries require this type of certificate is included in the table of immunization requirements contained in the Guide. (In the near future, it is believed that the Armed Forces will adopt a type of immunization record closely approximating the international model, which should eliminate any difficulty in this respect.)

The Air Surgeon, Military Air Transport Service, will furnish copies of the Guide to anyone requesting them, but in view of the limited facilities in that office for maintenance of an extensive mailing list, the preferred method of distribution is in bulk to major Air, Army, and Navy commands for further internal distribution by those agencies. Individuals or organizations desiring copies may obtain them by communicating with:

Commander
Military Air Transport Service
Andrews Air Force Base
Washington 25, D. C.
Attention: Air Surgeon

As changes occur, they will be reported by consecutively numbered changes to the Guide. Holders of the Guide will realize maximum benefit from it only if they post changes immediately upon receipt. The Guide is revised and reissued from time to time as the accumulation of changes makes a new edition feasible. The Air Surgeon, MATS, has extensive channels of information through which the Guide is kept up to date, but will, nevertheless, appreciate an immediate report by users as to any instance of incompleteness or inaccuracy. Such reports should embody sufficient information as to allow verification of the data reported.

About the Army Medical Department

PAUL I. ROBINSON, *Colonel, MC, U. S. A.*[1]

THIS month's article covers the subject of certain Medical Service Corps officers who, on separation from their commissioned status, are eligible to take noncommissioned grades as master sergeants. The Personnel Division receives almost daily inquiries on this subject. Undoubtedly many medical officers in the field are also receiving queries on this subject. It is hoped that this article will reach those Medical Service Corps officers who have to take this matter into consideration when planning their careers.

Separation of Officers Desiring Enlistment in Grade VII

RALPH J. RICHARDS, JR., *Major, MSC, U. S. A.*

The criteria announced by the Department of the Army for officers to enlist in grade VII (formerly grade I) on completion of their current category, as stated in paragraph 13, SR 135–215–5, is a cause of increasing concern within the Medical Department. Although requests for exception to this regulation have been submitted with consideration of the best interests of the service, it is deemed advisable to acquaint all personnel concerned that the Department of the Army does not contemplate authorizing any exceptions to the regulation. On the surface, perhaps it appears that the Department of the Army does not recognize the potential loss of specialists and key officers who may desire to avail themselves of a permanent grade VII status. Further, it may appear that the Department of the Army does not recognize the desirability of continuing certain officers in a commissioned status. There are, no doubt, many other assumptions that may be made, but an investigation of policy will reveal that appropriate consideration was given to each.

The need for stabilizing the enlisted grade structure precipitated the establishment of this policy. All officers who served during the recent war were given the assurance that they would have the opportunity to enlist in grade VII. Early in 1947, the Department of the

[1] The Personnel Division, Office of the Surgeon General.

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Army attempted to institute a similar program, realizing that a sound enlisted promotion program could not be administered until the maximum number of officers who would revert to grade VII could be determined. Because of the international unrest and the weakness of the Army resulting from demobilization, the Army was forced to defer this action. The complexities of administering an enlisted career program, therefore, became increasingly acute. Thus, it was determined that remedial action should be taken at an early date. The essential matter for consideration then became "What date?" It was decided that the guarantee for officers to enlist in grade VII would expire in the calendar year 1951. This year was decided on because it was believed that it would afford the most equitable treatment to all concerned. It will be recalled that Department of the Army Circular 27 dated 3 February 1948 required all volunteer officers other than those in the Regular Army either to select a new category III statement, or be separated from the service. These category statements will expire in 1951 on the anniversary of an officer's birth. Further, it will be recalled that in June 1948, the 80th Congress enacted Public Law 810 entitled, "Army and Air Force Vitalization and Retirement Equalization Act of 1948" (Joint Army and Air Force Bulletin 29, 15 July 1948). Included in this law was the provision "That any officer on the active list of the Regular Army, Regular Air Force, or Philippine Scouts, or any officer of the Reserve Components of the Army of the United States or of the Air Force of the Army of the United States, who shall have completed not less than 20 years' or more than 30 years' active Federal service in the Armed Forces of the United States, at least 10 years of which shall be active commissioned service, may in the discretion of the Secretary of the Army or the Secretary of the Air Force, as the case may be, be retired upon his own application. * * *"

In evaluating these factors and analyzing the number of officers on duty on 22 March 1948, it was concluded that nearly all such officers will have completed at least 7 years' commissioned service by 1951. With this conclusion, the policy was established affording officers who were on duty on 22 March 1948 the opportunity of electing, on completion of their category in 1951, separation from the service as a commissioned officer with a guarantee to be allowed to enlist in grade VII under existing criteria, or extension of category statement and foregoing the guarantee of enlisting in grade VII. Those who elect to enlist in grade VII will obtain the security afforded by permanent status, but they will defer their attainment of 10 years' commissioned service necessary to qualify for retirement in their highest commissioned grade. Those who elect to extend their category and thus attain 10 years' commissioned service will accrue the retirement ad-

vantages previously mentioned. Officers in this category will, however, forego their guarantee to be allowed to enlist in grade VII after completion of their commissioned status. It should be understood, however, by all who elect this latter category that under the provisions of WD Pamphlet 12–16 they will be entitled to enlist in a grade not higher than grade VI (formerly grade II) on their reversion to enlisted status. The specific grade will depend on each person's qualifications.

It may, therefore, be seen that the policy, while apparently severe, is equitable. It requires an officer to determine which alternative he considers to be more desirable. The question may arise as to what would preclude an officer from electing to revert to grade VII on completion of his category in 1951 and immediately returning to extended active duty. The answer may be obtained by referring to an established Department of the Army policy which generally precludes the recall to active commissioned duty of personnel serving within the Department of the Army. In evaluating this regulation, primary consideration must be given to the effect its implementation will have on the operations of the Medical Department in the event a large number of officers elect to return to an enlisted status. It is the opinion of both the Department of the Army and the Office of the Surgeon General that the majority of officers will extend their category and no critical shortage of personnel will occur. There will be some shortage but it will be met by the procurement of replacements, by direct appointment from civil life, distinguished military graduates, recall of former officers from civil life, and graduates of Officer Candidate Schools.

In summary, the vitalization in the commissioned ranks and the opportunity for the stabilization of the enlisted grade structure resulting from this program outweight any adverse factors.

It is requested that this article be brought to the attention of all concerned because of the general misunderstanding of the determining factors underlying the provisions of paragraph 13, SR 135–215–5.

THE PHYSICIAN MUST KNOW WHAT HIS PREDECESSORS HAVE KNOWN IF HE DOES NOT WISH TO DECEIVE BOTH HIMSELF AND OTHERS.—*Hippocrates.*

EDITORIALS

The Implications of Military Medicine

Since the founding of this country, the military surgeon and the military medical services have made notable contributions to the treatment and control of disease. Many of their achievements stemmed from research and investigation stimulated by the exigencies of war, but an equal number have been the result of work and observations during periods of peace; all have been a boon not only to the health and welfare of the personnel of the Armed Forces but to mankind as well. As an example, Surgeon John Jones, in 1775, was the author of the first surgical textbook in the American colonies. Major William Beaumont's observations were of fundamental value in the physiology of digestion. The contributions of Major General George Sternberg to bacteriology and to medical literature justly entitle him to be designated as the father of American bacteriology. The contributions of Rear Admiral Edward Stitt to the medical literature in the fields of bacteriology and tropical medicine have been of real value to the military medical services and to the medical world. The field of the military surgeon has been global in nature and has encompassed every branch of medicine. Reed and his associates solved the enigma of the transmission and control of yellow fever; Ashford's discovery that *Necator americanus* was the factor in Puerto Rican anemia was a noteworthy accomplishment; construction of the Panama Canal was made possible by the work of General Gorgas in mosquito control; Darnell's introduction of liquid chlorine for the purification of drinking water is now of world-wide acceptance and has been of inestimable value in the control of water-borne diseases. Brigadier General Kelser's observations that equine encephalomyelitis is spread by the mosquito and his introduction of vaccine to control rinderpest were of immense value to animal husbandry. These are only a few of the many notable contributions of the military surgeon.

The military medical services have always kept abreast of scientific developments and they have continually worked in close collaboration with their confreres in the civilian medical and scientific worlds. In recent years, particularly those just prior to World War II, this collaboration with civilian medicine has brought out many measures in medicine and surgery that have been of great importance to all people. Included in this work was the mass production and the evaluation of the clinical application of penicillin; the evaluation and use of DDT as a personnel and environmental insecticide, many engineering devices were introduced and utilized for aerial and ground dissemination of this insecticide. Malaria, because of its world-wide incidence and because of the unavailability of quinine, required further study to determine substitutes for quinine in treatment. This work involved the pharmacologic study of over 14,000 chemicals and proved the value of atabrine and other drugs in the suppressive treatment of malaria.

The use of blood and blood plasma in the treatment and control of shock, and the use of tetanus toxoid as an immunizing agent were factors that reduced the mortality rate in wounded personnel of the Armed Forces to the lowest point in medical history, for during the past war, out of every 100 wounded men, 97 survived. The use of other immunizing agents such as vaccine for smallpox, typhoid fever, typhus fever, cholera, plague, yellow fever, and Japanese encephalitis was of primary importance in reducing the mortality rate from disease among the personnel of the Armed Forces to an all-time low. During the period 1942–45, although 11,300,000 persons served in the Armed Forces, deaths and disabilities from malaria, typhoid, typhus, and diarrheal disease were of negligible proportions; these diseases were responsible for the majority of deaths in all wars prior to World War I. Further, these results were attainable because of concomitant engineering developments in miltary medicine which made possible the elimination of insect- and water-borne diseases. Today outbreaks of epidemic diseases are no longer to be feared, for they are eliminated in their incipiency by immunizing the host and destroying the vector.

In the field of aviation medicine the work of the military medical services, in collaboration with military and civilian aeronautical engineers, has permitted airplane design and construction based on medical and physiologic considerations. The military surgeon, because of his first-hand knowledge of physical and psychologic environmental conditions during flight at altitudes and speeds which, in some instances, exceeded human physical tolerance, made possible many advances in military airplane design and construction. His observations regarding the many factors that evoke physical and psychologic

impairment in the pilot have enabled him to establish standards in the selection of pilots. Practically all the advances in aviation design have stemmed from military aeromedical research. The pressurized cockpit and aircraft cabin, the "G-suit," oxygen masks, the elimination of the hazards of carbon monoxide in aircraft, and many other devices have all served to benefit civilian as well as military aviation.

The flight surgeon, in collaboration with civilian scientists, solved many problems relating to the field of visual acuity in air personnel; he helped to develop optical instruments of effective design; dark adaptation goggles with which personnel are enabled to go into action with good night vision for the performance of critical night duties, devised measures to protect the pilot against gravity forces during turns and provided him with the "ejection seat" and many other safety measures of great value.

The work of the military medical services has been a constructive factor in the discovery of new chemical therapeutic agents for the treatment of cholera, amebiasis, filariasis, and schistosomiasis. They appraised the prophylactic and therapeutic value of penicillin and the sulfonamides in infection and defined the appropriate field for use. The experience gained has demonstrated that penicillin is a powerful antibacterial agent in the treatment of bacteremia, peritonitis, osteomyelitis, and many other serious infections, and also that, with the use of penicillin, the field of curative surgery can be extended to include many conditions in which surgical intervention in infection was previously not feasible.

The military services made great contributions to the problems relating to the optimum time for surgical intervention and the best method for repair of peripheral nerve lesions. Other contributions to surgery included the use of "fibrin foam," and oxidized cellulose as hemostatic agents and proof that these agents were nonirritating, nonantigenic, and absorbable. They spearheaded the use of blood and blood derivatives, the application of methods of accumulating and preserving large stores of whole blood and making it available for immediate shipments to the field; methods of drying plasma to provide adequate accumulated stores to meet military needs, and the use of blood fractions such as human serum albumin in the treatment of shock, all were real advances in surgery and therapeutic measures readily applicable and of great value to civilian medicine.

The fields of investigation of the military surgeon were not limited to clinical methods in medicine, surgery, and preventive medicine. The problems of acclimatization to heat and cold and the determination of factors which influence tolerance to extremes in temperature were investigated; food composition and its preparation, and the in-

fluence of nutritional factors were studied. The results achieved were such as to enable personnel to remain healthy regardless of geographic locations, whether in the frigid Arctic zone or in the torrid zone of the Tropics.

Keeping in mind the necessity for postwar rehabilitation of war casualties, the military medical services have produced many prosthetic devices, among which are included the acrylic eye, plastic glove for artificial hands, and an improved prosthesis for above-elbow and above-knee amputees. These devices will be of unquestioned value to both military personnel and to the civilian who must meet and overcome similar physical handicaps.

Military medicine is a specialty that embraces every phase of medicine, surgery, hygiene, sanitation, medical military logistics, and medical military administration. In this enlightened age of scientific development the military medical services possess a firm knowledge not only of the ever-expanding clinical phases of medicine and surgery, but also of the practical application of the many developments in technology to military medicine. The military surgeon is fully at home in diverse fields among which are included the physical effects of atomic radiation on men and matériel; the military medical aspects of special weapons; the practical application of aero-medical research to aviation design; the practical application of research in submarine medicine to design and performance of the submarine.

In his unassuming manner the military surgeon has forged ahead surely and steadily armed with vision, courage, and a will for unrelenting toil. He exemplifies the finest type of physician, aware of the newest in science, realizing his responsibilities to his fellow man, and sharing equally with him the dangers of the battlefield. Guided by Hippocratic medicine he is mindful of the physical and psychologic welfare not only of our military personnel but also of all mankind.

Operation Manuscript

The preparation of a manuscript for publication should entail, among other things, a regard for the reader. Sir Arthur Quiller-Couch appropriately summed up this thought in his statement "You must be your own reader, chiseling out the thought definitely for yourself, and after that must carve out the intaglio yet more sharply and neatly, if you would impress its image accurately upon the wax of other men's minds."

The following is an outline of what are considered to be the essential points in the preparation of a manuscript.

The title should be concise and informative.

The introduction should be short, setting out the reason for writing the article such as: A need for supplying information necessary to fill a gap in knowledge or to settle a controversial subject; to provide information regarding the effects of a new drug; to describe a new syndrome, a new method, or a new instrument.

It is not necessary to include a long historical review, however a brief résumé of historical facts may be required.

The text should be concise and factual, new, important, and useable. The continuity of ideas or topics must be clearly set forth between the paragraphs as well as the sentences. The sentences must be direct, correct, and effective. Eliminate verbiage. To include techniques that are well known is unnecessary. In discussing the etiology the inclusion of a dissertation of commonly known facts or a recitation of theoretic causes of a disease when the causal factors are unknown or controversial is superfluous.

Inclusion of extensive statistics, graphs, and tables detracts from interest in the article. Whenever feasible these should be contained in summarized form in the text to bring out the important points.

The discussion of the data presented should be brief.

An article, unless it is short, should contain a good summary from which the reader can obtain important information. The summary should include all important facts contained in the article; it should not be a table of contents.

In writing case reports economy and efficiency of expression are necessary. Only the symptoms that are attributable to the lesion should be related. Similarly only the essentials in the history, the physical examinations, and the laboratory reports, insofar as they relate to the diagnosis, should be included. The findings at autopsy or at operation should be brief and pertinent. To include irrelevant points in history, a description of routine technique, or laboratory and physical findings that are patently normal, is superfluous.

The bibliography should be pertinent to the subject and need not be extensive unless the article deals with a survey of the literature of a subject.

To be useful and interesting a manuscript must contain facts clearly related to the subject, stated simply and plainly, in logical order, and written in terms adapted to a scientific report. Showy writing, coined words, and poor construction of sentences reduce the value of otherwise informative material.

The Army Medical Research and Development Board

The focal point of the Army's investigative activities in the field of medicine and allied science is the Medical Research and Development Board, organized on 17 August 1945. This Board took over the activities of the Technical Division, Operations Service, Office of the Surgeon General, and the Office of Scientific Research and Development, both of which were discontinued at the end of World War II. The mission of the Board is to formulate and supervise a coordinated medical research and development program. The Board consists of a full-time chairman, full-time chief of the Development Branch, full-time chief of the Research Branch, and representatives of the Air Force Surgeon General, the National Research Council, and various divisions of the Office of the Surgeon General of the Army. Five military and sixteen civilian assistants conduct the routine administrative matters of the Board. The Board may delegate its powers and functions to committees and may hire civilian consultants when necessary.

In the interval between the two World Wars, the Army Medical Department's research and development was quite restricted. It was difficult during those years to conduct a continuing integrated program, but research and development did go forward. Certain specialized research and development work was done by the Tropical Research Board in Panama; at the Professional Service Schools (now the Army Medical Department Research and Graduate School) of the Army Medical Center in Washington, D. C.; at the Army Institute of Pathology (now the Armed Forces Institute of Pathology); the Army Chemical Center in Maryland; and at the Medical Department Equipment Laboratory at Carlisle Barracks, Pa. The scattered accomplishments fell short of the need, and the result was that the Medical Department found itself under a severe handicap as World War II approached. It appeared that demands for answers to military medical research problems would have to be met by improvisations and the hurried marshaling of what knowledge was available among civilian and technical personnel from established research centers.

In 1939, the Surgeon General took steps to obtain the aid of qualified civilians through the Division of Medical Sciences of the National Research Council. With the establishment of the Office of Scientific Research and Development in 1941, further cooperation between the Army Medical Department and civilian medical institutions was effected. Also in 1941, the Army Epidemiological Board was created, functioning as an adjunct to the Preventive Medicine Division of the Surgeon General's Office and spearheading the Medical Department's

work in combating communicable diseases. The Armored Medical Research Laboratory was set up at Fort Knox, Ky., in 1942, to conduct certain lines of environmental and physiologic research and development. At about the same time, the study of nutrition was resumed on a small scale in the Division of Nutrition, at the Army Medical Center, Washington, D. C. The food laboratory was subsequently moved to Chicago to be near the large food industries and the Quartermaster Subsistence Research and Development Laboratory. Further efforts to promote and coordinate Army medical research and development continued through various organizational changes, culminating in the activation of the Technical Division, Operations Service, Office of the Surgeon General. This Division was established early in 1944 to perform administrative activities incident to the Medical Department research program, to establish liaison with other agencies in matters pertaining to medical research, and to coordinate development, testing, standardization, and reclassification of Medical Department items. The Medical Department Research and Development Board represents the final step in a long effort to achieve a coordinated program of military medical research and development.

In addition to the usual medical problems encountered by the medical professions at large, military medicine deals with problems peculiar to the Armed Forces and not always encountered in civil life. The Armed Forces must anticipate the Nation's wartime requirements and undertake to provide answers before information is needed in a time of national emergency. The Board works on such problems as (*a*) physical and mental standards for the most efficient use of manpower; (*b*) prevention and care of casualties caused or complicated by radiation injury; (*c*) living and working conditions under extreme cold; (*d*) the prevention of cold casualties; (*e*) the evacuation and medical and surgical care of sick and injured soldiers under conditions of extreme cold; (*f*) preventive medicine and medical practice in disaster relief; (*g*) traumatic surgery, including first aid, resuscitation, operative, and postoperative care, and rehabilitation; (*h*) psychiatric and psychologic problems which bear on the prevention of psychiatric casualties in war; (*i*) control of infectious and parasitic diseases among troops and displaced populations during war; and (*j*) nutritional problems of the severely injured and infected, and displaced persons who have undergone starvation, or who must be cared for when adequate food is not available.

The range of these investigations can best be illustrated by some specific examples of current projects. On assignment from the Board, the Fish and Wildlife Service is engaged in a search for a North American animal susceptible to the virus of infectious hepatitis. The adaptation of this virus to lower animals is a necessary preliminary

to the study of the cause and control of the disease, which, during the recent war, became so widespread as to interfere with military operations. A contract with the New York Medical College calls for investigation of the physiology, pathology, and therapy of frostbite, immersion foot, trench foot, and general exposure to cold. A project at the Medical College of Virginia is concerned with the study of extensive thermal burns such as those obtained in the presence of an atomic explosion. A unit at Yale University is undertaking a thorough evaluation of the mental health capacities and adaptability of our national population, so that manpower may be used efficiently during emergencies, and is attempting to develop new and improved methods of minimizing losses of manpower caused by psychiatric conditions. Investigators at the University of Cincinnati are working on problems of gas gangrene and cerebral edema following head injuries.

Among recent accomplishments in which the Board played an important part are: (*a*) the development of streptomycin; (*b*) the development of Chloromycetin; (*c*) the testing of Dramamine; (*d*) the development of improved prosthetic devices; (*e*) the development of new splints and braces; (*f*) the finding that administration of thyroid may prolong the survival time of personnel unprotected from the cold and enhance their chance of recovery; (*g*) the development of penicillin in the prophylaxis of rheumatic fever; and (*h*) the development of chlorguanide and chloroquine diphosphate for the treatment and prevention of malaria.

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TEXTBOOK OF GENITO-URINARY SURGERY, edited by H. P. Winsbury-White, M. B., Ch. B., F. R. C. S. (Edin.), F. R. C. S. (Eng.); *Surgeon, St. Paul's Hospital for Genito-Urinary Diseases; London; Urologist, Princess Elizabeth Hospital for Children; Lecturer, Institute of Urology and (in Urology) Institute of Child Health, University of London;* with 40 contributors. 1,041 pages, illustrated. The Williams & Wilkins Co., Baltimore, Md., publishers, 1948. Price $20.

The publication of a "tome of the size and importance of this volume," is an event of outstanding importance in the urologic world. It is a worthy successor to another excellent British text, Thompson-Walker's popular work on genito-urinary surgery. In general concept of design, this new book is reminiscent of that great American reference work, Cabot's "Modern Urology," the last edition of which appeared in 1936.

This volume of 83 chapters is written by 40 outstanding genito-urinary surgeons and clinicians of the British Empire and covers the medical, as well as the surgical, problems of urology.

The numerous magnificent illustrations, both black and white and in color, are noteworthy. Because of the employment of numerous side and center headings, in various type, the book falls naturally into outline form and, accordingly, the acquisition of information is rendered comparatively simple.

Each system of the urinary tract, beginning with the kidneys, and of the male genital tract is treated in logical sequence from the surgical point of view. The surgical and applied anatomy, histology, embryology, and physiology of each organ are discussed following which there is exhaustive description of methods of examination, morbid anatomy, surgical, and nonsurgical treatment is undertaken.

References to urologic literature are numerous, complete, and remarkably up to date.

Of particular excellence are the sections devoted to the physiology of micturition and the disturbances of micturition resulting from nervous diseases. Especially timely is the lucid and complete discussion of the urologic care of the paraplegic. A lively controversy has been waged concerning the value of tidal drainage as advocated by Donald Munro. F. J. F. Barrington advocates suprapubic drainage. Particularly excellent are the sections devoted to the male and female urethra and to the operative management of urethral strictures.

If any one section of this magnificent book may be singled out for particular praise, it is the section devoted to the prostate gland. Here, in addition to a careful and complete consideration of the classic suprapubic and perineal methods, are sections devoted to the transurethral resection of the prostate by the methods of McCarthy and of W. F. Braasch and his associates at the Mayo Clinic. A complete discussion by Terence Millin of his retropubic operation is included as well as one by Wilson C. Hey on his unique modification of the total, radical prostatectomy involving a trigonectomy and removal of the seminal vesicles with, in malignant disease, a partial cystectomy. The treatment of carcinoma of the prostate by castration and synthetic estrogens is discussed adequately.

Following a long section devoted to the external male genitalia, there is a careful, up-to-date consideration of infections and calculus disease of the urinary tract. The sections devoted to the employment of the sulfonamides and various antibiotics are especially complete, timely, and up to date. The treatment of urogenital tuberculosis is particularly noteworthy for its completeness. The discussions of schistosomiasis, hydatid disease and actinomycosis of the genito-urinary tract are the most complete the reviewer has seen in any text of urology.

Calculus disease is thoroughly treated and the various concepts of stone formation adequately reviewed. Surgical and nonsurgical (enzyme, dietary, and dissolution) methods are discussed thoroughly.

The tremendously important subjects of impotence and sterility are adequately considered; descriptions of testicular biopsy and artificial insemination are timely.

The last chapter is devoted to an extremely important subject: "Management of Glycosuria in Genito-urinary Surgery"; its inclusion evidences the completeness of this great book.

There is a most complete and carefully prepared cross-index.

This work is certainly one of the most practical available, and as a reference book for the student and general practitioner of medicine, it should be of great value. To the resident or practicing genito-urinary surgeon it is of inestimable value as a source of the most modern information on technical details of urological diagnostic methods as well as nonsurgical and operative procedures.

—*Commander S. Johnson (MC), U. S. N.*

PATHOLOGY, edited by W. A. D. Anderson, M. A., M. D., F. A. C. P., *Professor of Pathology and Bacteriology, Marquette University School of Medicine, Milwaukee, Wisc.*, with 32 collaborators. 1,453 pages, illustrated. The C. V. Mosby Co., St. Louis, Mo., publishers, 1948. Price $15.

This is a new textbook of pathology edited by the author of the popular "Synopsis of Pathology." In this new volume of 1,453 pages Dr. Anderson has collaborated with a group of 32 pathologists, each with outstanding qualifications and with specialized knowledge in particular aspects of pathology. The result has been the production of perhaps the most comprehensive and authoritative work on pathology ever to appear in a single volume.

The book is divided into 36 chapters, most of which are written by a single author. A large number of references are listed at the end of each chapter. The order of presentation of subjects, which does not radically depart from that of other texts in the same field, serves to facilitate its use both as a textbook for medical students and as a reference for physicians. There are 1,183 illustrations and 10 color plates. The black and white illustrations are mostly new and technically excellent. Interspersed among the pages of conventional sized print are many paragraphs and sometimes several pages of rather fine print dealing with subjects apparently considered of secondary or lesser importance. This might brook some criticism, but this reviewer considers that it was essential in order to limit the size of the book. For completeness, it is better to include this material in fine print rather than to omit it altogether.

The book is thoroughly up-to-date. The subject matter has followed and kept pace with changing world conditions. This is noted particularly in the considerable space devoted to effects of radiation and the increased stress on viral and tropical diseases. Also given somewhat more than the customary attention for a book on pathology are the sections on skin, bone, and special senses. The book is very well edited.

As a standard, comprehensive, and up-to-date treatise on pathology, this book is highly recommended.—*Capt. W. M. Silliphant (MC) U. S. N.*

ORAL SURGERY, Volumes I and II, by Kurt H. Thoma, D. M. D., *Professor of Oral Surgery and Brackett Professor of Oral Pathology, Harvard University; Oral Surgeon and Chief of Dental Department, Massachusetts General Hospital; Honorary Professor of the Odontologic Faculty, San Carlos University, Guatemala; Visiting Lecturer on Oral Surgery, University of Pennsylvania; Oral Surgeon, Brooks Hospital; Consulting Oral Surgeon, New England Baptist Hospital, Beth Israel Hospital, Tumor Department of Boston Dispensary, Joseph H. Pratt Diagnostic Hospital, Faulkner Hospital; Consultant in Oral Surgery, U. S. Public Health Service Marine Hospital, Boston; Consultant in Oral Pathology to the Surgeon General, Department of the Army, Washington, D. C.* 1,521 pages; 1,631 illustrations, 121 in color. The C. V. Mosby Co., St. Louis, Mo., publishers, 1948. Price $30.

Dr. Thoma's comprehensive tome is a presage of the future of dentistry wherein the success of surgical technique is but a reflection of the accuracy of diagnosis and adequacy of treatment, predicated upon an exact knowledge of oral pathology. Dr. Thoma's two volumes pertinently emphasize the essential correlation of surgical procedures with basic anatomical and pathological processes.

This work is unparalleled in the field of oral surgery. It is most comprehensive in scope, yet combined with an exquisiteness of detail; its organization is excellent, a standard format being maintained throughout the discussions of the various surgical phases; and of supreme importance, the procedures demonstrated are basically sound, obviously demonstrating a background replete with experience.

The general organizational pattern follows a logical sequence, beginning with basic surgical principles, progressing through minor oral surgical procedures, oral malignancies, and facial deformities. Indications for operation, general preparation of the patient, anesthesia, details of operative procedure, and postoperative treatment and complications are covered thoroughly. Numerous radiographs, photographs, and pen and ink drawings record the steps of the surgical procedures. The excellent collection of pertinent case histories presented at appropriate intervals vitalize the details.

Of extreme interest to the general dentist and exodontist is the chapter on dentoalveolar surgery. This section, replete with graphic step by step drawings and case histories, adequately discusses most phases of the routine surgery that practitioners might encounter.

The division concerning the treatment of traumatic (injuries) diseases of the jaws is comprehensive. The techniques for the reduction and fixation of

facial fractures and the treatment of concurrent complications are graphically portrayed. The author clearly describes the techniques and appliances which, in his experience, have been successful for the reduction and immobilization of maxillofacial fractures. Dr. Thoma's reference to skeletal fixation might have been amplified advantageously by comment as to its limited indications, emphasizing the necessity for continuous alertness to avoid consolidation in malposition with consequent impaired occlusal function. Particularly noteworthy is his statement as to the desirability of the early reduction of middle-face fractures in the absence of cerebral damage requiring priority in treatment.

The chapter on antral perforations and pertinent surgery, and that on osteomyelitis and jaw necrosis, demonstrate quite vividly the procedures by which the surgeon extricates himself from predicaments sequent to unavoidable complications, faulty surgery, or judgment.

Infections of the face and neck are discussed in such a manner that one not only receives instruction in the surgical approach but also in facial anatomy and surgical pathology. This is of special value, not only in treatment but particularly in the prevention of potentially fatal sequelae, such as Ludwig's angina or a cavernous sinus thrombosis.

Neoplasms, both benign and malignant, are considered at great length. Here the reader is referred to Dr. Thoma's previous text, "Oral Pathology," for a background in the clinical and histopathologic pictures of the various conditions. The surgical procedures presented in this chapter progress from the relatively simple to the more radical, and again are accurately described in great detail.

In summation, these two volumes are unique in that they represent the most thorough and complete coverage of the field of oral surgery up to this time. Not only should they be indispensable additions to the libraries of oral surgeons and general dental practitioners, but they should also be at hand for the ready reference of physicians and general surgeons.—*Capt. M. M. Maxwell (DC) U. S. N.*

BOOKS RECEIVED

Receipt of the following books is acknowledged. As far as practicable, these will be reviewed at a later date.

GERIATRIC MEDICINE, The Care of the Aging and the Aged. Edited by Edward J. Stieglitz, M. S., M. D., F. A. C. P., *Attending Internist, Suburban Hospital, Bethesda, Md. (Chairman, Staff, 1945–47); Doctor's Hospital, Washington, D. C.; Attending Internist (Geriatrics), Chestnut Lodge, Rockville, Md.; Consulting Internist, Washington Home for Incurables; Associate, Washington School of Psychiatry; Special Lecturer, Institute of Industrial Medicine, New York University, Bellevue Postgraduate Medical School, New York City; Formerly Associate Clinical Professor of Medicine, Rush Medical College, The University of Chicago.* 2d edition. 773 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1949. Price $12.

1948 YEAR BOOK OF DERMATOLOGY AND SYPHILOLOGY, edited by Marion B. Sulzberger, M. D., *Professor of Dermatology and Syphilology, Post-Graduate Medical School, New York University-Bellevue Medical Center; Director of Department of Dermatology and Syphilology, New York Skin and Cancer Unit;* and Rudolph L. Baer, M. D., *Assistant Professor of Clinical Dermatology and Syphilology, Post-Graduate Medical School, New York University-Bellevue Medical Center.* 560 pages, 75 illustrations. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1949. Price $5.

AN INTRODUCTION TO ZEN BUDDHISM, by Daisetz Teitaro Suzuki, D. Litt., *Professor of Buddhist Philosophy in the Otani University, Kyoto.* Foreword by C. G. Jung, M. D., LL. D., D. Litt., D. Sc. 136 pages. The Philosophical Library, New York, N. Y., publishers, 1949. Price $3.75.

ORAL AND DENTAL DIAGNOSIS, With Suggestions for Treatment, by Kurt H. Thoma, D. M. D., F. D. S. R. C. A., Eng.; *Professor of Oral Surgery Emeritus, and Brackett Professor of Oral Pathology, Harvard University; Lecturer on Oral Surgery, The*

Graduate School of Medicine, University of Pennsylvania; with contributions by Henry Goldman, D. M. D., *Head of the Dental Department, Beth Israel Hospital, Boston,* and Fred Trevor, D. M. D., *Formerly Instructor in Oral Pathology, Harvard Dental School.* 3d edition. 563 pages; 776 illustrations, 60 in color. W. B. Saunders Co., Philadelphia, Pa., publishers, 1949. Price $9.50.

SYPHILIS: ITS COURSE AND MANAGEMENT, by Evan W. Thomas, M. D., *Professor of Clinical Medicine, New York University College of Medicine; Director, Rapid Treatment Center and Visiting Physician, Bellevue Hospital, New York; Consultant, United States Public Health Service.* Foreword by John F. Mahoney, M. D., *Director of Venereal Disease Research Laboratory, United States Public Health Service.* Chapter on "Public Health Aspects of Syphilis" by Theodore J. Bauer, M. D., *Chief, Venereal Disease Division, United States Public Health Service.* 317 pages. The Macmillan Co., New York, N. Y., publishers, 1949. Price $5.50.

THE 1948 YEAR BOOK OF ENDOCRINOLOGY, METABOLISM AND NUTRITION. Endocrinology, edited by Willard O. Thompson, M. D., *Clinical Professor of Medicine, University of Illinois College of Medicine; Attending Physician (Senior Staff) Henrotin Hospital; Attending Physician, Grant Hospital of Chicago.* Metabolism and Nutrition, edited by Tom D. Spies, M. D., *Chairman, Department of Nutrition and Metabolism, Northwestern University School of Medicine; Director, Nutrition Clinic, Hillman Hospital, Birmingham, Ala.* 544 pages; illustrated. The Year Book Publishers, Chicago, Ill., publishers, 1949. Price $4.50.

CLINICAL ALLERGY, by Louis Tuft, M. D., *Assistant Professor of Medicine, Temple University, School of Medicine, and Chief of Clinic of Allergy and Applied Immunology, Temple University Hospital, Philadelphia, Pa.* 2d edition. 690 pages; 54 illustrations and 3 plates in color. Lea & Febiger, Philadelphia, Pa., publishers, 1949. Price $12.

PSYCHOSOMATIC MEDICINE, The Clinical Application of Psychopathology to General Medical Problems, by Edward Weiss, M. D., *Professor of Clinical Medicine, Temple University Medical School, Philadelphia;* and O. Spurgeon English, M. D., *Professor of Psychiatry, Temple University Medical School, Philadelphia.* 2d edition. 803 pages. W. B. Saunders Co., Philadelphia, Pa., publishers, 1949. Price $9.50.

FUNCTIONAL NEURO-ANATOMY, by A. R. Buchanan, M. D., *Professor of Anatomy, University of Colorado School of Medicine, Denver, Colo.* 242 pages with 199 illustrations, 19 in color. Lea & Febiger, Philadelphia, Pa., publishers, 1948. Price $6.50.

THE STORY OF SCABIES, Vol. I, The Prevalence (Civil and Military), Prevention and Treatment of Scabies, and the Biology of *Acarus Scabici,* from the Earliest Times to the beginning of World War II, by Reuben Friedman, M. D., *Associate Professor of Dermatology and Syphilology, Temple University School of Medicine; Fellow of the College of Physicians of Philadelphia; Member of the Philadelphia Dermatological Society, American Academy of Dermatology and Syphilology, Society for Investigative Dermatology, and American Association of the History of Medicine; Corresponding Member of the Italian Society of Dermatology and Syphilography and the Cuban Society of Dermatology and Syphilography; Diplomate of the American Board of Dermatology and Syphilology.* Foreword by Carroll S. Wright, M. D., *Professor of Dermatology and Syphilology, Temple University School of Medicine.* 468 pages, with 114 illustrations and 36 tables. Froben Press, Inc., New York, N. Y., publishers, 1947. Price $7.50

CLINICAL PRACTICE IN INFECTIOUS DISEASES, for Students, Practitioners, and Medical Officers, by E. H. R. Harries, M. D., (Lond.), F. R. C. P., *Medical Superintendent, North-Eastern Hospital (London County Council); formerly Medical Superintendent, City Hospital, and University Clinical Lecturer in Fevers, Birmingham; Milroy Lecturer, Royal College of Physicians, London;* and M. Mitman, M. D. (Lond.), F. R. C. P., *Medical Superintendent, River Hospitals; formerly Medical Superintendent, Eastern Hospital, and Divisional Medical Officer, Public Health Department, London County Council.* Foreword by Sir Allen Daley, M. D. (Lond.), F. R. C. P., *Medical Officer of Health, London County Council.* 3d edition. 679 pages, illustrated. The Williams & Wilkins Co., Baltimore, Md., publishers, 1947. Price $6

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